

Utah Department of Transportation



**Supplemental Specifications
for**

**2004 Standard
Specifications**

**FOR ROAD AND BRIDGE
CONSTRUCTION**

U.S. Standard Units (Inch-Pound Units)

Issued May 27, 2004

Memorandum

UTAH DEPARTMENT OF TRANSPORTATION

DATE: May 27, 2004

TO: Holders of Hard Copy of Standard Specifications

FROM: Barry Axelrod, CDT
Standards and Specifications

SUBJECT: Supplemental Specifications Distribution, dated May 27, 2004

Applicable files for the change are attached. Maintain these files as a supplemental update to the UDOT Standard Specifications dated March 15, 2004. No pages are to be removed or replaced in the basic book, electronic or hard copy.

If you are in need of electronic copies of any Standard or Supplemental Specification please refer to the Standards and Specifications Web site at <http://www.udot.utah.gov/index.php?m=c&tid=302>. From there select the **2004 Standards** subtopic.

If you have any questions or problems with the electronic files contact me at 801-964-4570 or by email at baxelrod@utah.gov.

Attachments

Listing of Supplemental Specifications

Issue Date: May 27, 2004

Revised April 29, 2004

Section 01554M Article 3.2 A1b (deleted)

Section 01721 Entire section revised to correct oversight. Article 3.5 H (added).

Replaces Standard Specification.

Section 02822M Article 2.4 B (revised)

Section 13551 Entire section revised. Replaces Standard Specification.

Section 13552 Entire section revised. Replaces Standard Specification.

Section 13553 Entire section revised. Replaces Standard Specification.

Section 13554 Entire section revised. Replaces Standard Specification.

Section 13555 Entire section revised. Replaces Standard Specification.

Section 13556 Entire section revised. Replaces Standard Specification.

Section 13557 Entire section revised. Replaces Standard Specification.

Section 13561 New section added.

Section 13591 Entire section revised. Replaces Standard Specification.

Section 13592 Entire section revised. Replaces Standard Specification.

Section 13593 Entire section revised. Replaces Standard Specification.

Section 13594 Entire section revised. Replaces Standard Specification.

Section 13595 New section added.

**Supplemental Specification
2004 Standard Specification Book**

Section 01554M

TRAFFIC CONTROL

Delete Article 3.2, paragraph A1b.

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SECTION 01721

SURVEY

Delete Section 01721 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Schedule, coordinate, and provide all construction surveying, staking, measurement and calculations (including measurement and calculation of quantities for contract pay items measured or paid for by area or volume) essential to complete the project and properly control the entire work.
- B. Directed surveying as requested by the Engineer.

1.2 RELATED SECTIONS

- A. Section 02765: Pavement Marking Paint

1.3 MEASUREMENT PROCEDURES

- A. Directed Survey: If extra survey work is needed, a 2-Person Crew measured by the hour authorized. Department makes no additional payment for travel time to and from the project.
- B. Directed Survey: If extra survey work is needed a 3-Person Crew measured by the hour authorized. Department makes no additional payment for travel time to and from the project.

1.4 PAYMENT PROCEDURES

- A. If contract does not include separate pay item for survey, include the costs in all items of work that require survey. Failure to comply with any portion of this specification may result in withholding up to 25 percent of contract payments until the deficiencies are corrected.

- B. If needed and approved, directed survey work paid for in the accepted quantities at the following rates:

2 person survey crew	\$130.00 per hour
3 person survey crew	\$155.00 per hour
1 person computation and /or CAD	\$ 65.00 per hour

- C. The number of hours required for computations and/or drafting in total cannot exceed 33 percent of actual survey hours, established on a percent basis prior to directed survey work starts.

1.5 SUBMITTALS

- A. The Department requires that a Professional Engineer or Professional Land Surveyor registered in the State of Utah sign and seal all submittals.
- B. Resubmittals may be required depending on completeness and correctness of the work.
- C. Prior to beginning work, submit a statement indicating all Department-provided horizontal and vertical control have been field checked and the control has been determined to be accurate within the tolerances specified in this section. Attach field survey information used to verify control. If discrepancies are found, notify the Engineer verbally and in writing.
- D. Prior to beginning work, provide a written description of the equipment (including calibration certifications), manpower, methods, and data storage format proposed for use to complete all survey activities.
- E. Record keeping: Keep all field notes, diaries, and books according to standard surveying practice.
1. Loose leaf books not acceptable.
 2. Make available at any time all survey records including field notebooks and forms used for the work to the Engineer upon verbal or written request.
- F. Submit electronic files, plots and calculations of appropriate contract pay item quantities to the Engineer for review and approval, a minimum of 3 working days prior to the pre-determined estimate cut-off date.
- G. After project completion, return to the Engineer all surveying and design data and provide a red-lined hard copy plan set showing as-constructed features denoting changes from the original design.

1.6 QUALITY ASSURANCE

- A. Contractor is responsible for survey and control of the work, and for correcting Contractor errors, whether the errors are discovered during the actual survey work or in subsequent phases of the project. Bear any cost overruns resulting from Contractor errors.
- B. Perform all work in accordance with the plans and specifications and standard Engineering and Surveying practices under the responsible charge of a Professional Engineer or Professional Land Surveyor duly and properly registered in Utah.
- C. The Engineer may spot check the work for accuracy and may reject unacceptable portions of work. Resurvey rejected work and correct work that is not within the specified tolerances at no additional expense to the Department.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. Furnish tools, supplies, and stakes suitable for use in highway survey work.
- B. Furnish stakes and hubs of sufficient length to provide a solid set in the ground with sufficient surface area above ground for necessary legible markings.
- C. Furnish survey instruments and supporting equipment capable of achieving the specified tolerances. Calibrate survey equipment for accuracy prior to beginning survey work and as required.

PART 3 EXECUTION

3.1 PREPARATION

- A. Discuss and coordinate the following with the Engineer before survey work begins:
 - 1. Required submittals
 - 2. Survey and staking methods
 - 3. Stake markings
 - 4. Grade control
 - 5. Referencing

6. Structure control
 7. Any other procedures and control necessary for the work
 8. Documentation procedures
- B. Establish construction survey points, elevations and grades as necessary to control layout and complete the work. Verify all control surveying and staking meets specified tolerances for prior to beginning work.
- C. Calculate all grades, elevations, offsets and alignment data necessary for staking and/or setting items of work. Obtain approval from the Engineer for alternate methods of establishing grade control with wire lines, computer or laser controlled grading or other suitable methods.
- D. Provide appropriate traffic control for all survey activities.
- E. The Department furnishes:
1. Plans showing locations of control points
 2. Plans showing locations of Bench Marks
 3. Cross sections developed during design, if any
 4. Electronic project data, if any
 5. Digital Terrain Model used for design, if any

CONTRACT PROVISION DISCLAIMER

RELEASE OF UDOT DATA: Contractor may obtain an electronic copy of the Data Points prepared by UDOT. UDOT provides data points in Microstation and/or Inroads format only. Contractor responsible for translation into other formats. This data does not include the commercial software needed to read the points. In order to obtain an electronic copy, Contractor makes a written request to the Engineer. Contractor agrees and understands that the data points are prepared by UDOT for its own purposes and not for the benefit of private individuals or businesses. Contractor waives any and all claims that may result from the use of or reliance upon the data points. Contractor indemnifies UDOT and holds it harmless for any damages, costs, attorneys' fees, or other liabilities that might be incurred as a result of the Department's use and reliance on the data.

3.2 DIRECTED SURVEY

- A. Conduct directed surveying if requested by the Engineer.
1. Includes work needed for changes and extra work. Provide all labor, materials, and equipment including global positioning satellite equipment.
 2. Obtain prior written authorization from the Engineer documenting the affected work and requirements before performing work under these items.

3.3 COMPUTATIONS AND PLOTS

- A. Use cross-sections to calculate volume measurements.
 - 1. Superimpose final cross sections with original cross sections and calculate final quantities using the average end area method.
 - 2. Develop cross-sections from field measurements.
 - a. Take cross section measurements both before and after excavation and prior to backfill.
 - b. When the centerline curve radius is less than or equal to 500 ft, take cross sections at a maximum centerline spacing of 25 ft.
 - c. When the centerline curve radius is greater than 500 ft, take cross sections at a maximum spacing of 50 ft.
 - d. Take additional cross sections at breaks in terrain and at changes in typical sections.
 - e. For each cross section, measure and record points at breaks in terrain, but at least every 25 ft unless otherwise approved by the Engineer.
 - f. Measure and record points to at least the anticipated slopes and reference locations.
 - g. Reduce all cross section distances to horizontal distances from centerline.
 - h. Take cross sections at right angles to tangents and normal to curves.
 - i. Include in cross sections all grades, locations, and existing ground line profiles.
 - 3. May develop cross sections from digital terrain models provided that:
 - a. The ground survey locations do not exceed 100 ft in any direction
 - b. Major breaks in terrain are also included.
 - c. The horizontal and vertical control for the project is used
 - d. The DTM is verified accurate to require tolerances by spot checking throughout the length of the project.
- B. Engineer may approve alternate methods of calculating quantities.

3.4 STAKE MAINTENANCE AND MARKING

- A. Maintain ALL staking necessary for the work until the construction has been completed and accepted by the Engineer.
 - 1. Legibly mark all survey stakes with station and offset referenced to their respective control line.
 - 2. Mark slope, reference and guard stakes with station.
 - 3. Renew illegible stakes at no additional cost to the Department.

- B. Provide and maintain reference stakes that identify stationing at least every 100 ft until all work has been completed and accepted by the Engineer.

3.5 CONTROL POINT AND SURVEY TOLERANCES

- A. Relocate initial horizontal and vertical control points in conflict with construction to areas that will not be disturbed by construction operations. Furnish the coordinates and elevations for the relocated points before the initial points are disturbed.
- B. Protect bench marks from construction activities. Position all bench marks to allow a level rod to stand vertically and squarely on the mark. Reference bench marks to centerline and horizontal measurements.

C. Survey and establish control within the following tolerances:

Description	Horizontal	Vertical
	Decimals of a foot	
Control points	± 0.01	± 0.01
Centerline points	± 0.03	± 0.02
Cross sections and slope stakes	± 0.10	± 0.10
Slope stake references	± 0.10	± 0.10
Culverts and Ditches	± 0.10	± 0.05
Minor drainage structures	± 0.10	± 0.03
Curb and gutter	± 0.02	± 0.02
Guardrail and concrete barrier	± 0.05	± 0.05
Retaining walls	± 0.05	± 0.01
Bridge substructure and overall	± 0.01	± 0.01
Bridge superstructure and overall	± 0.01	± 0.01
Environmental Control Limits	± 1.00	-----
Clearing and grubbing limits	± 1.00	-----
Right of Way Limits	± 0.02	-----
Roadway subgrade finish stakes	± 0.10	meet tolerance of succeeding layer
Roadway finish grade stakes	± 0.04	meet tolerance of succeeding layer
Signals and electrical	± 0.05	± 0.02
Striping	± 0.08	-----
Paving reference line	± 0.04	± 0.01

Coordinate the survey tolerances of any items not listed above with the Engineer.
Tolerances given above are subordinate to any tolerances listed in other specifications.

D. Staking limits:

1. Stake clearing limits on both sides of centerline at each established station. Locate the clearing limit on the ground as shown by the cut and fill limits on the plans.
2. Stake right of way limits every 50 ft maximum on tangents, every 25 ft maximum on curves and at all right of way breaks. If staking distance is affected by line of sight, reduce the distance.

3. Stake environmental control limits on both sides of centerline at each established station. Locate the environmental control limits on the ground as shown by the slope rounding contours and environmental and silt fence locations as shown on the Plans. Stake environmental control limits every 50 ft and every 25 ft where environmental or silt fence is required.
- E. Furnish reference stakes for all slope stakes and stakes used for setting items for work.
1. Maintain the reference stakes for the duration of the project until the Engineer approves removal.
 2. Establish and set slope stakes and references on both sides of centerline at cross section locations.
 - a. When the centerline curve radius is less than or equal to 500 ft, place slope stakes at a maximum centerline spacing of 25 ft.
 - b. When the centerline curve radius is greater than 500 ft, place slope stakes at a maximum spacing of 50 ft.
 3. Establish slope stakes in the field as the actual point of intersection of the design slope with the natural ground line.
 4. Set slope stake references outside the clearing limits.
 5. Include all reference point and slope stake information on the reference stakes.
- F. After the slope staking is completed, record on the cross section guard stakes the vertical distance from the reference point (RP) to the construction grade, at a minimum horizontal distance of 10 ft outside the clearing limits or at right of way.
- G. Setting grade finishing stakes:
1. For grade elevations and horizontal alignment:
 - a. On centerline.
 - b. On each shoulder at roadway cross section locations and between centerline and shoulder with a maximum spacing of 15 ft.
 - c. At the top of subgrade and the top of each aggregate course.
 2. Locations:
 - a. Where turnouts are constructed, set stakes on centerline, on each normal shoulder, and on the shoulder of the turnout.
 - b. In parking areas, set hubs at the center and along the edges of the parking area.
 - c. Set stakes in all ditches to be paved.
 3. Maximum spacing between stakes along the alignment: 50 ft.
 4. Use brushes or guard stakes at each grade finishing stake.
 5. Reset grade finishing stakes as many times as necessary to construct the subgrade and each aggregate course.

- H. The following Advanced Traffic Management System (ATMS) As-Built requirements apply to all ATMS device installations, that include but are not limited to Ramp Meters, Closed Circuit Television (CCTV), Variable Message Sign (VMS), Roadway Weather Information System - Environmental Sensor Station (RWIS-ESS), Weigh In Motion (WIM), and Fiber Optic Communication Systems.

1. Department:
 - a. Provide project design files to Contractor in MicroStation format.
2. Contractor:
 - a. Carefully document all changes and updates all files to accurately represent the system as-built conditions.
 - b. Plot three sets of the updated files on 11-inch x 17-inch bond paper and submit the plots to the Engineer for review and approval.
3. As-built drawings will not be considered complete until the Engineer has given formal approval of the plots and design files.
4. Include the following in as-built drawings:
 - a. Site plans with distances.
 - b. Final cabinet configuration, including wiring schematic.
 - c. Pin-outs for any custom connectors.
 - d. Laminated copy of the detector layout for the site, consisting of site map and including detector numbering, locations, and input file designation.
 - e. GPS coordinates for all junction boxes, conduit runs (250 foot intervals), and ATMS devices. Include latitude, longitude, and elevation in WGS 84 format to nine decimal place precision (XXX.XXXXXXX) in coordinates.

3.6 CONCRETE PAVING

- A. Develop a method of horizontal and vertical control for the placement of concrete pavement.
1. Utilize laser, wire, or string line, for example, to maintain horizontal and vertical control.
 2. Maximum spacing: 50 ft.
 3. Set control on both sides of roadway.
- B. Stake concrete joint and station stamp locations.

3.7 DRAINAGE STRUCTURES

- A. Stake drainage structures to fit field conditions and in coordination with the Engineer. The location of the structures may differ from the plans.
 - 1. Survey and record the ground profile along the centerline of the structure.
 - 2. Determine the slope catch points at inlets and outlets.
 - 3. Set reference points and record information necessary to determine structure length and end treatments.
 - 4. Stake ditches or grade to make the structure functional.
 - 5. Plot the profile along centerline of the structure to show the natural ground, the flow line, the roadway section, and the structure.
 - 6. Mark guard stakes with the following, when applicable:
 - a. Diameter, length and type of culvert (for example 18 inch x 35 ft corrugated metal pipe (cmp))
 - b. The vertical and horizontal distance from the hub to the invert at the end of the culvert or any intermediate point as needed or directed
 - c. Flow line grade of the pipe
 - d. Station
 - 7. For storm sewers and waterlines provide a reference at a maximum spacing of 50 ft. Reference inverts of pipe at all manholes.

3.8 BRIDGES

- A. Set a minimum of 3 horizontal and vertical control reference points to be used for surveying all bridge substructure and superstructure components, including but not limited to; pile locations and cutoffs, line and grade for abutments and bents, beam seats, anchor bolts and screed grades.
- B. Set intermediate slope stakes at bridge abutments to establish transitions. Place finish grade stakes on the centerline of abutment bearing and at the top of slope of all bridge berms. Place finish grade stakes on each side at top, mid-point or slope and toe of fill.

3.9 BOX CULVERTS

- A. Set horizontal and vertical control and reference points. Establish and reference the centerline, back of parapet, skew, and flow line elevations at inlet, outlet and breaks.

3.10 CURB AND GUTTER

- A. Set curb and gutter staking at 25 ft intervals on tangent and 10 ft intervals on curve radii. Set line and grade for curb and gutter within 0.02 ft. of the proposed or established grade line.

3.11 GUARDRAIL

- A. Stake guardrail vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curved sections unless otherwise approved.

3.12 EXISTING SURVEY MONUMENTS

- A. Under the direction of a surveyor licensed in the State of Utah, locate and reference all private and public land survey monuments that may be destroyed by project construction activities prior to disturbing those existing monuments.
- B. Complete referencing and reestablishing those existing monuments at no cost to the Department and before project completion.
- C. In some counties the county surveyor references and reestablishes the monuments.
 - 1. Notify the county surveyor at least 30 days prior to the destruction of any monument.
 - 2. Coordinate the reestablishment of section corner and quarter corner monuments with the county surveyor.
 - 3. Submit drawings and notes showing references to section corners and quarter corners to the Engineer.
- D. If a monument is found during construction but is not shown on the contract plans and must be reset, the Department pays for the additional work under the Directed Survey item.

3.13 RETAINING WALLS

- A. Set horizontal and vertical control and reference points. Establish and reference the centerline offsets for the walls, radius points, and the beginning and ending wall locations as shown on the plans.
- B. Stake retaining wall vertical and horizontal control at a maximum spacing of 25 ft on tangent sections and 10 ft on curved sections unless otherwise approved.

3.14 PAVEMENT MARKING

- A. Layout all temporary and permanent pavement markings per Section 02765.

3.15 CLEANUP

- A. Remove and dispose of all flagging, lath, stakes and other staking material after the project is complete.
 - 1. Place references for traffic striping a minimum of 150 feet apart on tangents and a minimum of 50 feet on curves.

3.16 UTILITIES

- A. As part of cooperating with the utility companies, stake control lines as needed so their facilities can be relocated to their proper final position. Also, stake crossings or potential points of conflict between facilities to give proper horizontal and vertical control for the relocation. Schedule this survey work with the utility companies to minimize delays and disruption of survey stakes. Replace all disturbed stakes as necessary to facilitate the relocations. The Contractor is responsible for costs incurred to relocate any utility more than once due to inaccurate or incomplete staking.

END OF SECTION

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Section 02822M

RIGHT-OF-WAY FENCE AND GATE

Delete Article 2.4, paragraph B and replace with the following.

- B. Round or sawed rectangular post and braces.
 - 1. Round posts must have a minimum diameter of 5 inches.
 - 2. Gate brace and corner posts must have a minimum diameter of 5 inches.
 - 3. Rectangular posts must have a minimum dimension of 4 inches x 6 inches.
 - 4. Square members, a minimum of 4 inches x 4 inches may be rough sawn or S4S.
 - 5. A line drawn between the centers of the butt and tip of each post and brace rail must be inside of the actual longitudinal centerline of the post or rail within 1.67 percent of its length.
 - 6. Taper (diameter differential) in round members must not exceed 2 inches in 10 ft.
 - 7. Fabricate posts and brace rails before pressure treatment of the wood members.
 - 8. Field drill only after all exposed untreated surfaces of members are field treated with two coats of the same material as they were originally treated.
 - 9. Treat post and brace rail following Section 06055.
 - 10. Keep round posts free of bark, protruding knots, or other irregularities.

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Section 13551

GENERAL ATMS REQUIREMENTS

Delete Section 13551 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install all ATMS components as defined on the plans, specifications, details, and special provisions.
- B. Provide all documentation required for the installation and testing of ATMS components.

1.2 RELATED SECTIONS

- A. Section 00725: Scope of Work
- B. Section 01554: Traffic Control
- C. Section 01721: Survey
- D. Section 13554: Polymer Concrete Junction Box
- E. Section 13591: Traffic Monitoring Detector Loop
- F. Section 15595: ATMS Integration

1.3 REFERENCES

- A. ASTM: A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. ASTM: A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

- C. ASTM D 3005, Type I or II. UL 510
- D. American Wire Gauge (AWG)
- E. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications
- F. International Municipal Signal Association Regulations
- G. National Electric Code (NEC)
- H. Rural Electrical Association (REA) Bulletins
- I. Underwriters Laboratory (UL)
- J. USDA Rural Utilities Service (RUS) Bulletin

1.4 DEFINITIONS

- A. ATMS - Advanced Traffic Management System
- B. CCTV - Closed Circuit Television
- C. RMS - Ramp Meter System
- D. RWIS - Road Weather Information System
- F. TMS - Traffic Monitoring Station
- G. VMS - Variable Message Sign
- H. WIM - Weigh In Motion

1.5 SUBMITTALS

- A. Provide all required submittals as described in this section, article 2.1, paragraph A.

1.6 WARRANTY

- A. Provide warranties of merchantability and fitness for a particular purpose for all furnished equipment, as a whole, each of its components, and the workmanship for the duration of one year from the date of acceptance of the entire project by the Department.
- B. Warranties are not required for State Furnished equipment.
- C. Take any corrective action necessary during the Warranty Period, within 72 hours after notification by the Engineer to restore any identified deficiency caused by defective workmanship or materials. Repair or replace defective items. Notify the Engineer when corrective action has been completed.

PART 2 PRODUCTS

2.1 DOCUMENTATION

A. SUBMITTALS

- 1. Provide two copies of all documentation to the engineer.
- 2. Provide one copy of the test reports, configuration data, and as-built drawings in each of the field cabinets.
- 3. The general purpose and content of all required submittals is described in the following list. The details of the submittal requirements for each ATMS device type can be found in the appropriate Standard Specification, Supplemental Specification, or Special Provision for the ATMS device.
 - a. Contractor Furnished Material and Equipment Lists: The lists will include the name of the manufacturer, size, and identification number.

- b. Test Reports: After the completion of a successful test, provide a test report for the Cable and Conductor Test, the Local Field Operations Test, and Acceptance Tests. Refer to the section, Article 3.1 of this Standard Specification or the respective Standard Specification or Special Provision. Obtain UDOT's newest version of the test procedures for the local field operations test from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>. Test Reports are required for each appropriate ATMS device installation, including, but not limited to CCTV, VMS, RWIS, WIM, Traffic Monitoring Detector Loops or other specified detection device, and Fiber optic communication systems. Provide Test Reports in a neatly bound (3-hole) and printed format. The Test Reports will include the following items:
1. All test results (including failed tests)
 2. Description of any observed discrepancies
 3. Description of required corrective action
 4. Estimated time to complete corrective action and re-test
 5. Results of any corrective action
- c. Completion Notice: Provide a Completion Notice to the Engineer after all devices have successfully passed the Local Field Operations Tests, and all ATMS components are ready to begin Acceptance Tests. The Completion Notice consists of the certification that all ATMS installations are compliant with all project requirements. Use the Local Field Operations Testing Completion Notification Form obtained from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
- d. Compliance Certificate: Provide an installation compliance certification by the manufacturer on required equipment.
- e. Manufacturer's Equipment Documentation: For all Contractor furnished items, provide all factory issued manuals per this section, article 2.1, paragraph C, software, detailed shop drawings, wiring diagrams, certifications, warranties, instruction sheets, and parts lists to the engineer.
- f. As-Built Drawings: Refer to Section 01721.

B. DOCUMENTATION TIMELINE

1. The following list describes the conditions under which submittals must be provided:
 - a. Contractor Furnished Material and Equipment Lists: Submit within fifteen business days from the Notice to Proceed. All Contractor furnished equipment must be approved by the Engineer prior to ordering.
 - b. Test Reports: Submit within five business days from the completion of a successful test.
 - c. Compliance Certificate: Submit within five business days of receipt by the Manufacturer for each site.
 - d. Completion Notice: Submit within five business days prior to the beginning of the Acceptance testing.
 - e. Manufacturer's Equipment Documentation and As-Built Drawings: Must be received and accepted prior to Final Acceptance.
2. The Engineer accepts or rejects submittals within ten business days. Rectify and resubmit rejected submittals within five business days, or as specified by the Engineer.

C. FACTORY ISSUED MANUALS

1. Acceptable factory manuals must contain technical, diagnostic, and maintenance (preventative and troubleshooting) information. Advertising brochures and catalog cuts not accepted.

2.2 WIRING

- A. Copper, as specified. International Municipal Signal Association (IMSA).
- B. Size as specified. American Wire Gauge (AWG).
- C. Service Cable:
 1. Single-conductor, as specified. Type THWN, THW, THHW.
- D. Signal Cable:
 1. Multi-colored cables, as specified.
 2. IMSA 20-1
- E. Ground Wire:
 1. Solid, bare, soft-drawn, copper wire, as specified.
 2. NEC 250.1.

- F. Splice Sealing: Rural Electrical Association (REA) Bulletin 345-72.
 - 1. Use approved direct buried, rigid body splice kits with reenterable, gel-filled encapsulant and listed in the USDA Rural Utilities Service (RUS) List of Materials, Informational Bulletin (IP) 344-2, Section 2 - **Housings, Splice Cases, etc.** Properly size for the cable or wire being spliced.
 - 2. ASTM D 3005, Type I or II. UL 510.
- G. Power Conductors:
 - 1. Power conductors, copper, type RHH, USE, RHW.
- H. RS-232/RS-422 Cables:
 - 1. 24 AWG stranded tinned copper drain wire.
 - 2. 4 twisted pairs.
 - 3. Overall aluminum-polyester shielded.
 - 4. PVC jacket.
 - 5. Nominal outside diameter of 0.28 in.
 - 6. Nominal impedance of 100 (ohms).
 - 7. Nominal capacitance of 12.8 pF/ft between conductors.
 - 8. Nominal capacitance of 25 pF/ft between one conductor and the other conductors connected to shield.
- I. Category 5 Cable (CAT-5) as specified in ANSI/TIA/EIA-568-B. Refer to NEC, Article 800.
- J. Detector Cables as specified in Section 13591.

PART 3 EXECUTION

3.1 TESTING AND ACCEPTANCE

- A. The following tests will be required for all appropriate ATMS devices:
 - 1. Cable and Conductor Test
 - 2. Local Field Operations Test
 - 3. Acceptance Tests
- B. Notify the Engineer five working days prior to the proposed date and time of all tests.
 - 1. Obtain UDOT's newest version of the Five-Day ATMs Testing Prenotification Form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.

2. The Engineer or the Engineer's Agent witnesses the tests.
- C. Before any connections are made, perform the Cable and Conductor Test.
 1. Obtain UDOT's newest version of the ATMS Cable and Conductor Test Form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
 2. Prior to any testing, verify that all cables and conductors are installed as per the manufacturer's plans and recommendations.
 3. Perform all resistance testing after final termination and cable installation, but prior to the connection of any electronics or field devices.
 4. Replace the cable, then retest new cable as specified above should any cable fail to meet these parameters, or should any testing reveal defects in the cable.
 5. Furnish all equipment, appliances, and labor necessary to test the installed cable and conductors.
- D. Refer to the appropriate Standard Specification, Supplemental Specification, or Special Provision for device specific Field Operations Test procedures.
- E. Refer to Section 13595 for Acceptance testing procedures.

3.2 EXISTING FACILITIES

- A. Until Final Acceptance, repair any damage to any traffic signal equipment, lighting equipment, utilities, and other ATMS devices, including but not limited to, conduit, junction boxes, underground traffic signal circuits, power sources, or power conductors, that are caused by the Contractor's activities, or failure to maintain adequate traffic control or protection of the work. (This includes items to be salvaged, such as: cabinets or poles.) Request a meeting with the Department and the party with current maintenance responsibility to verify that all existing equipment is in working order at the work site. Test all loops, cabling, connectors, cabinet operations, etc. Request, coordinate, and conduct the on-site meeting and provide all labor, materials, test equipment, and test documentation. All testing will be non-destructive. If work begins at a location without arranging this testing, it will be assumed that all cabinet components and operations were in proper working order at that time and responsibility assumed for proper operation upon completion of the work. If no pre-testing is completed, any equipment that is not functioning at the time the work is completed, will be assumed to have been working at the project start and must be replaced at the Contractor's expense.

- B. Locate and mark all utilities prior to initiation of construction. Contact Blue Stakes and schedule the location of underground utilities. Contact any utilities and local government agencies not participating in Blue Stakes locate services. Any utilities shown on the plans concerning the type and location of existing underground and overhead utilities is shown in an approximate manner only and have not been independently verified by the Engineer or the Engineer's Agent. Determine the exact location of all existing utilities before commencing work, and be fully responsible for any damage that might result from the Contractor's failure to locate and preserve any underground and overhead utilities.
- C. Following any repairs to underground facilities, contact the Engineer for inspection, prior to restoring cover.
- D. If any conflicts with existing facilities are identified, contact the Engineer to re-locate any project foundations, trenches, or other items, prior to further construction work.
- E. Arrange to have a utility company inspector on site when doing any construction within ten feet of existing facilities.
- F. Place electrical service requests and orders as well as all other necessary utility coordination with all utility companies in an efficient manner as to not delay the project.
- G. Any pre-marking of ATMS equipment locations in the field by the designer has been performed without consideration of existing underground utilities. Determine any conflicts with existing utilities at locations pre-marked in the field by the Designer.
- H. Do not proceed on work occurring outside Department right-of-way until the required permits, environmental clearances, and approvals are obtained from all local entities.
- I. Do not cut any limited access fences.
- J. Perform all digging using hand tools, without power equipment if any construction is to take place within two feet of existing facilities.

3.3 LOCATION OF INSTALLED EQUIPMENT

- A. Proposed equipment locations may be modified to avoid conflict with underground utilities or other obstructions. Consult Engineer for approval.

- B. Install all above ground equipment the maximum practical distance from traffic or behind barrier or other approved protection.
- C. No portion of the equipment can infringe within the following distances unless behind a barrier or other approved protection.
 - 1. 35 ft. from the edge of traveled way for a freeway
 - 2. 35 ft. from the edge of traveled way for an off ramp
 - 3. 50 ft. from the edge of traveled way for an on ramp
- D. Minimum distance behind guardrail for all above ground equipment: 4 ft.
- E. Minimum distance behind concrete barrier for all above ground equipment: 2 ft.

3.4 EXCAVATION

- A. Do not damage streets, sidewalks, landscaping, or other surrounding conditions when excavation is required.
- B. Do not excavate wider than necessary for the proper construction of the foundations and other equipment.
- C. Do not perform excavation until immediately before construction of foundations.
- D. Place the material from the excavation in a position that will minimize obstructions to pedestrian or vehicular traffic and interference with surface drainage.
- E. Remove all surplus excavated material and properly dispose of it within 48 hours as directed by the Engineer.
- F. Notify the Engineer after each excavation is completed that the site is ready for inspection..
- G. Do not cover any underground materials or equipment fill under any circumstances, without the approval of the Engineer.
- H. Barricade and cover all excavations to provide safe passage for pedestrian and vehicular traffic at the end of each working period.
- I. Keep sidewalk and pavement excavations well covered and protected to provide safe passage for pedestrian and vehicular traffic until permanent repairs are made.

3.5 ANCHOR BOLTS

- A. Place and hold anchor bolts in proper alignment, position, and height during the placing and vibrating of concrete.
- B. Assemble bolts, nuts, washers and torque bolts as required by the manufacturer.
- C. Conform to minimum requirements of ASTM A 307 for anchor bolts. Do not weld anchor bolts to reinforcing steel. Galvanize all nuts, washers and anchor bolts in accordance with ASTM A 153.

3.6 TRAFFIC CONTROL

- A. Refer to Section 01554.
- B. Submit all lane closure and traffic control plans to the Department for approval. Refer to Section 01554.
- C. Contact each business manager 48 hours prior to construction affecting any business access. Place BUSINESS ACCESS signs where access to business is not readily apparent. Keep at least one driveway open during periods when business is open for businesses with multiple driveways. Coordinate with the business owner for businesses with only one driveway to minimize the amount of time that the driveway is closed.

3.7 TEMPORARY TRAFFIC SIGNAL TIMING

- A. Design and implement any temporary traffic signal timing or phasing required for traffic management during construction. Submit any proposed timing or phasing changes, including any temporary signal head placement, to the Engineer for review and approval seven days in advance.
- B. Implement the approved temporary changes including for example, programming the controller, relocating traffic signal heads and, recabbling. Contact the Engineer for inspection (giving 24 hours notice) prior to implementing temporary phasing.

3.8 REUSE EXISTING CONDUIT AND JUNCTION BOXES

- A. Reuse existing conduit when no new adjacent conduit is being installed.

- B. Reuse only existing conduit that meets NEC requirements and Department standards for conduit material and depth of cover.
- C. Replace existing plastic lid on all reused junction boxes with polymer concrete lid. Refer to Section 013554.

3.9 ABANDON ATMS EQUIPMENT IN PLACE

- A. Do not remove existing pull wire from conduit that is to be abandoned in place.
- B. Obliterate all existing foundations left in place to a depth of at least 6 inches below the existing surface. Properly dispose of removed concrete.
- C. Properly label each abandon ATMS equipment as “abandoned” in each junction box and all cables and conductors that are left in place.

3.10 REMOVE AND SALVAGE ATMS EQUIPMENT

- A. Remove existing equipment as specified.
 - 1. Maintain the integrity of the equipment during removal and transport. Contact the Engineer to arrange for an inspection by the Department to verify Equipment condition prior to removal, otherwise the equipment will be assumed functional and undamaged.
 - 2. Return equipment to the appropriate Department facility, as indicated by the Engineer.
 - 3. Contact Engineer at least 48 hours prior to removal.
- B. All removed poles and cabinets:
 - 1. Contact the Engineer at least 48 hours prior.
 - 2. Return to appropriate Department facility.
- C. Cable:
 - 1. Spool all cable to be salvaged neatly onto appropriately sized spools. Avoid cutting long cables whenever possible. Cut cables only at splice locations or as directed by the engineer. Cap wires as described in this section, Article 3.12.
 - 2. Do not exceed the minimum bending radius and the maximum pulling tension recommended by the manufacturer’s specifications at any time.

3.11 ELECTRICAL

- A. Perform all work in accordance with the National Electric Code (NEC).

3.12 INSTALL WIRING

- A. Conductors:
 - 1. Clean and dry the inside of the conduit before installing conductors.
 - 2. Install grounding conductor in all power circuit conduits (Refer to NEC, Article 250.1).
 - 3. Use powdered soapstone, talc or other approved lubricants when pulling conductors in conduit.
 - 4. Tape the ends of unused conductors and label them as spares.
 - 5. Use conductors that are color coded as specified in IMSA 20-1 and comply with NEC, Article 310.
- B. Ground wire:
 - 1. In all non-metallic conduit, a ground wire must run continuously and be grounded at each junction box, except in those conduits used solely for interconnect and detector circuits.
 - 2. Bond the ground wire to the ground rod in each junction box except in circuits with less than 50 V.
- C. Neatly arrange wiring within cabinets, junction boxes, fixtures, etc.
- D. Wire splicing:
 - 1. Splice wires only in detection circuits where the wire type changes in the junction boxes.
 - 2. Mechanically secure and solder, individually insulate, and water seal all splices. Encapsulate in a rigid body re-enterable gel filled enclosure approved by the department.
- E. Do not exceed the minimum bending radius or the maximum pulling tension recommended by the manufacturer's specifications at any time.
- F. Keep cable ends sealed at all times during installation using an approved cable end cap. Do not use tape to seal the cable end. Keep cable end sealed until connectors are installed.

3.13 MAINTENANCE

- A. Repair, replace, maintain and operate all installed ATMS devices until Final Acceptance. Includes but is not limited to:
 - 1. Replacement of damaged cabling.
 - 2. Repair or replacement of damaged conduit and junction boxes.
 - 3. Repair or replacement of Department and Contractor furnished items.

- B. Repair installation or replace equipment due to any damage as specified in Section 00725.
- C. Emergency Maintenance: Until Final Acceptance of the ATMS device, provide emergency maintenance on a seven-day per week, twenty-four hour basis. Respond to the dispatcher within fifteen minutes when called or paged by the dispatcher. Provide contacts and telephone numbers to the Engineer for the emergency service.
- D. Limit emergency maintenance (one hour response) to problems of a public safety nature, such as exposed wires or knockdowns.
- E. Routine Maintenance: Initiate other routine maintenance, not of a public safety nature, within twenty-four hours of notice.
- F. Failure to provide adequate routine or emergency maintenance will result in the Department performing the necessary maintenance or the selection a separate contractor by the Department to perform the work. The Contractor will be charged accordingly.

3.14 LOCATION OF NEW FACILITIES

- A. Locations staked in the field and dimensioned on the plans and details are approximate. Coordinate with the Engineer to have the Engineer or the Engineer's Agent on-site to field locate all new facilities such as cabinet foundations, camera poles, detector poles, and junction boxes.

END OF SECTION

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Section 13552

RAMP METER SIGNALS AND SIGNING

Delete Section 13552 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install conduit, junction boxes, wire, grounding, and foundations. Install all state furnished items. Includes all materials, labor, workmanship, equipment, testing, documentation, and incidental items required to install and test a complete and operational Ramp Meter system as shown on the plans and details.

1.2 RELATED SECTIONS

- A. Section 02891: Traffic Signs
- B. Section 02892: Traffic Signal
- C. Section 03055: Portland Cement Concrete
- D. Section 03211: Reinforcing Steel and Welded Wire
- E. Section 13551: General ATMS Requirements
- F. Section 13553: ATMS Conduit
- G. Section 13554: Polymer Concrete Junction Box
- H. Section 13555: ATMS Cabinet
- I Section 13591: Traffic Monitoring Detector Loop
- K. Section 16525: Highway Lighting

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- B. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- C. AASHTO M 284: Epoxy Coated Reinforcing Bars
- D. AASHTO Division II, Section 5
- E. AASHTO Standard Specifications for Highway Bridges
- F. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- G. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- H. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- I. American Iron and Steel Institute (AISI)
- J. American National Standards Institute (ANSI)
- K. Manual on Uniform Traffic Control Devices (MUTCD)
- L. National Electric Code (NEC)
- M. Underwriters Laboratories (UL)

1.4 SUBMITTALS

- A. Samples of materials to the Engineer for approval when requested.
- B. Provide all of the following submittals as described in Section 13551:
 - 1. Contractor Furnished Material and Equipment Lists
 - 2. Test Reports for the Cable & Conductor Test, the Local Field Operations Test, and the Thirty-Day Burn-In Test
 - 3. Completion Notice
 - 4. Compliance Certificate
 - 5. Manufacturer's Equipment Documentation

- 6. As-Built Drawings
- C. Local Field Operations testing is to be performed prior to the opening of all lanes to traffic.

PART 2 PRODUCTS

2.1 FOUNDATION

- A. Concrete: Class AA(AE) Concrete (Refer to Section 03055).
- B. Reinforcing Steel: Coated steel (Refer to Section 03211).

2.2 RAMP METER SIGNAL ASSEMBLY

- A. Signal Pole: Refer to Section 02892 and SL series Standard Drawings.
- B. For 12-inch signal heads: Refer to Section 02892. Louvered back plate required. Signal head housing: yellow.
- C. 8-inch 1 section signal head with red lens for enforcement. Signal head housing yellow. No back plate required.
- D. Regulatory Sign: MUTCD R10-6; 24-inch x 36-inch.
- E. For 8-inch signal heads: Refer to Section 02892. Louvered back plate required. Signal head housing yellow.
- F. 24-inch x 18-inch VEHICLE PER GREEN Sign: Refer to AT series Standard Drawings.
- G. Foundation Concrete: Class A(AE) Concrete (Refer to Section 03055).

2.3 MAST ARM SIGNAL ASSEMBLY

- A. Signal Pole: Refer to SL series Standard Drawings.
- B. For 12-inch signal heads: Refer to Section 02892. Louvered back plate required. Signal head housing yellow.

- C. 60-inch x 36-inch VEHICLE PER GREEN EACH LANE Sign: Refer to AT series Standard Drawings.
- D. Concrete: Class AA(AE) Concrete (Refer to Section 03055).
- E. Reinforcing Steel: Coated steel (Refer to Section 03211).

2.4 ADVANCE FLASHING BEACON SIGN

- A. Signal Pole: Refer to Section 02892 and SL series Standard Drawings.
- B. Two 8-inch signal heads with yellow lens: Refer to Section 02892. Signal head housing: yellow. No back plate required.
- C. Warning Sign: MUTCD W3-3 (modified for 2 lens ramp meter signal head), 36-inch x 36-inch.
- D. 30-inch x 24-inch black on yellow METERING WHEN FLASHING Sign: Refer to AT series Standard Drawings.
- E. Foundation Concrete: Class A(AE) Concrete (Refer to Section 03055).

2.5 BOLTS AND NUTS

- A. Follow Section 02892. Refer to ASTM A 307.

2.6 WIRE

- A. Follow Section 02892.

2.7 DETECTOR CIRCUIT

- A. Follow Section 02892.
- B. Consult the Engineer: Saw cut loops or pre-formed loops.

2.8 LUMINAIRE

- A. For luminaires installed on ramp meter signal pole, follow Section 02892.
- B. For luminaires not installed on ramp meter signal pole, refer to Section 16525.

2.9 GROUND ROD

- A. Copper-coated steel as specified.
- B. ANSI/UL 467.

2.10 CONDUIT

- A. Refer to Section 13553

2.11 Junction Box

- A. Refer to Section 13554

2.12 ATMS Cabinet

- A. Refer to Section 13555

2.13 MOUNTING BANDS AND BUCKLES

- A. As Specified.
- B. American Iron and Steel Institute, (AISI) Type 201.
- C. Universal Mounting Brackets for Signals mounted on mast arm.

PART 3 EXECUTION

3.1 PREPARATION

- A. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.
- B. Provide foundation, junction boxes, ground rod, grounding lug, conduit, signal heads, assemblies, and mounting devices, signs, and all additional equipment required for a complete and operational ramp meter system.

- C. Install all wiring, conduit, and junction boxes as shown on site plans and details.
 - 1. Field locate all conduit and junction boxes to avoid drainage areas and steep slopes whenever possible.
 - 2. Protect existing conductors while installing new conductors.
- D. Connect the controller and all wires as specified by the manufacturer.
- E. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the ramp meter system complete.
- F. After installation, the exterior of all equipment must be free of all rust and mill scale, dirt, oil, grease and other foreign substances.

3.2 FOUNDATION

- A. All material and workmanship conforms to AASHTO's Standard Specifications for Highway Bridges.
- B. Prior to work, verify that the installation of the signal heads, mast arm, pole, and foundation in the location marked in the field has no conflict with existing utilities, underground and overhead. Comply with all utility and Blue Stakes requirements.
- C. Place Ramp Meter Signal Assemblies 2 ft downstream of the stop bar and 4 ft outside of the edge of the shoulder. For Ramp Signal Assembly Details refer to AT series Standard Drawings.
- D. Place Mast Arm Signal Assemblies 40 ft to 120 ft upstream of stop bar. For Mast Arm Details refer to AT series Standard Drawings.
- E. Place Advance Flashing Beacon Assembly 350 ft to 375 ft upstream of stop bar. For Flashing Beacon Details refer to AT series Standard Drawings.
- F. Excavation: Refer to Section 13551
- G. Caissons conform to AASHTO Division II Section 5, Drilled Piles and Shafts. Caissons are drilled into either native soil or compacted fill.
 - 1. If formwork is required during drilling, the forms may be withdrawn during concrete placement.
 - 2. Cast the top of the caisson against the formwork for appearance.
- H. Place concrete directly into the excavation. Use minimum forming.

- I. Do not weld reinforcing steel, conduit, or anchor bolts; tie reinforcing steel and conduit securely in place.
- J. Coat all reinforcing steel to conform to AASHTO M284, M111 or ASTM A 153 and AASHTO M31 Grade 420, respectively. Coat the ends of cut reinforcing with approved epoxy coating.
- K. Use class AA(AE) for all cast-in-place concrete. Cap all conduits before placing concrete.
- L. Install weep hole in foundation per SL series Standard drawings.

3.3 ANCHOR BOLTS

- A. Refer to Section 13551

3.4 SIGNAL POLES

- A. Install the poles on new concrete bases. Apply rust, corrosion, and anti-seize protection to all threaded assemblies by coating the mating surfaces with an approved compound.
- B. Install pole with the hand hole facing away from traffic.
- C. Install ground rod per plans (NEC 250).
- D. All fasteners and attachment hardware for bands and other equipment: stainless steel.
- E. Adjusting the anchor bolt nuts, plumb all steel poles to the vertical with all signal heads and signs installed.
- F. Meet AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals for poles.

3.5 INSTALL WIRING

- A. Refer to Section 13551
- B. Mark cabinet cables with vinyl electrical color-coding tape as specified in Table 1. Meet UL 510 (Lanes numbered from left to right – include HOV bypass as left lane).

TABLE 1			
Cables Marked with Colored Tape			
	Lane One	Lane Two	Lane Three
Ramp Meter Circuit	Blue	Red	Yellow
Detector Circuit	Blue	Red	Yellow
Advance Flashing Beacon Signal	Blue and White	Red and White	Yellow and White

- C. Use Table 2 when connecting the conductors for ramp meter signal heads.

TABLE 2	
Color-Coded Conductors	
	All Lanes
Ramp Meter Signal Circuit	White- Neutral Red- Red indicative Green- Green indicative Blue- Enforcement (if present) or spare

3.6 ADVANCE FLASHING BEACON SIGN

- A. Follow Section 02891

3.7 RAMP METER SIGNAL ASSEMBLY SIGN

- A. Follow Section 02891

3.8 INSTALL SIGNAL HEADS

- A. Do not install signal heads at the intersection until it is ready for operation.
- B. If turn on is not immediate, completely cover signal heads with non-transparent, non-paper material tied securely around head.
- C. Install directed and veiled optically programmed signals following the manufacturer's instructions. Mask each section of the signal with recommended manufacturer's materials.

- D. Use louvered back plates on those signal heads indicated. Use a minimum of four 0.12-inch stainless steel screws per section to mount the back plates, or according to manufacturer's instructions.
- E. Orient meter-on ramp signal toward vehicles approaching the intersection stop-bar. Side Signal Head: axis or indication parallel to roadway surface.

3.9 INSTALL DETECTOR LOOPS

- A. Follow Section 02892
- B. For location of Presence and Discharge Loop refer to AT series Standard Drawings.
- C. For saw cut loops, consult the Engineer: circular or octagon shaped.

3.10 INSTALL LUMINAIRE

- A. Refer to Section 16525

3.11 TESTING AND ACCEPTANCE

- A. Perform a Detector Loop Inductance & Resistance Test as described in Section 02892. Submit Detector Loop Inductance & Resistance Test to the Engineer for acceptance.
- B. Perform the Local Field Operations Test after all ramp meter elements, equipment and hardware, power supply, detection device (Refer to Section 13591) and connecting cabling have been installed.
 - 1. Complete the Local Field Operations Test for Ramp Meters using the required form. Obtain UDOT's newest version of the form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
 - 2. Perform testing after all construction for the site has been completed and the final road surface has been constructed.
 - a. It is not necessary for the communications installation to be completed at the time testing.
 - b. It is not necessary that all stations be locally tested concurrently.

END OF SECTION

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Section 13553

ATMS CONDUIT

Delete Section 13553 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install conduit as shown on the plans and details. Unless otherwise specified, conduit may be installed by trenching, boring, or plowing.
- B. Includes locate wire with associated 1" conduit.
- C. Includes Mule Tape, all materials, labor, workmanship, equipment, and incidental items required for a complete system of conduit.

1.2 RELATED SECTIONS

- A. Section 00725, Scope of Work
- B. Section 01721: Survey
- C. Section 02061: Select Aggregate
- D. Section 02705: Pavement Cutting
- E. Section 02741: Hot Mix Asphalt (HMA)
- F. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork
- G. Section 02892: Traffic Signal
- H. Section 03575: Flowable Fill
- I. Section 13551: ATMS General Requirements

J. Section 13554: Polymer Concrete Junction Box

1.3 REFERENCES

- A. ASTM D 2241: Standard Specification for Poly-Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- B. American National Standards Institutes (ANSI)
- C. American Wire Gauge (AWG)
- D. American National Standards Institutes (ANSI)
- E. National Electric Code (NEC)
- F. National Electrical Manufacturers Association (NEMA)
- G. Railroad Specifications
- H. Underwriters Laboratory

PART 2 PRODUCTS

2.1 MATERIALS

- A. Conduit and Fittings:
 - 1. Schedule 40 PVC rated at 194 degrees F, as specified. NEMA TC-2, NEMA TC-3, ASTM D 2241, UL Listed.
 - 2. HDPE (High Density Polyethylene) SDR11 rated, as specified. ASTM D 2241.
 - 3. Rigid steel as specified (UL-6).
 - 4. Galvanized as specified (ANSI C80.1).
- B. Multi-Conduit
 - 1. New, prefabricated.
 - 2. Minimum of 4 each 2-inch conduit.
 - 3. Label: FIBER OPTIC COMMUNICATIONS, permanent ½-inch black letters, every 6 ft on the outside of each conduit.
 - 4. ATMS Conduit Types
 - a. 1D = 4-2 inch conduit
 - b. 2D = 8-2 inch conduit
 - c. 4D = 16-2 inch conduit

5. Color code each conduit or cell as follows:
 - a. 1D
Bank 1: one conduit of blue, orange, green and brown
 - b. 2D
Bank 1: one conduit of blue, orange, green, and brown
Bank 2: one conduit of slate, white, red, and black
 - c. 4D
Bank 1: one conduit of blue, orange, green, and brown
Bank 2: one conduit of slate, white, red, and black
Bank 3: same as bank 1 with a stripe of contrasting color
Bank 4: same as bank 2 with a stripe of contrasting color
- C. Provide all materials used in the installation of conduits, such as sweeps, adapters, couplings, glue, plugs and fittings, to meet or exceed all of the recommendations of the conduit manufacturer for suitable installation.
- D. Provide special termination kits from the conduit manufacturer for terminating the conduit in vaults and junction boxes. Provide kits that form a watertight seal of conduit to structure wall.
- E. Use complete conduit sections in nominal 20 ft sections; couplings and fittings to provide for watertight integrity.
- F. Use complete conduit manufactured 36" radius sweeps (11 1/4, 22 1/2, 45, 90 degree angles) complete with bell and spigot. Do not field bend conduit.
- G. Provide flat profile, low stretch polyester, sequential footage marked, 2500 lb. tensile strength Mule Tape or approved equal in each empty conduit or cell.
- H. Provide fiber optic and electrical buried cable marker warning tape that meets the following requirements:
 1. Material: Composite reinforced thermoplastic.
 2. Tape Color: Orange (communication) or Red (electric).
 3. Length: 5 ft minimum.
 4. Text: Caution Buried Communication Cable or Caution Buried Electric (front and back).
 5. Text Color: Black.
 6. Width: 3-inch minimum (face or diameter).
- I. Provide 1 jacketed #14 THHN solid green locator wire in 1 inch conduit in each trench where ATMS Conduit is installed. Place the locate wire conduit at the top of all other conduit in the trench as shown in AT series Standard Drawings.

- J. Provide locator wire connection device that meets the following requirements:
 - 1. Screw clamp connection type.
 - 2. Suitable for 22 to 8 AWG.
 - 3. Rated 50 amps.
 - 4. Rated 600 V.
 - 5. Provide zinc bichromate plated steel mounting rail for locator wire connection device.
- K. Backfill
 - 1. Flowable Fill: Refer to Section 03575.
 - 2. Free Draining Granular Backfill Borrow: Refer to Section 02061.
 - 3. Native material: 96 percent compaction.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Plans depict conduit routing in schematic form only. Base final routing on actual field conditions at the time of construction, including Blue Stake markings, to prevent conflicts with existing utilities.
- B. When installing conduit that houses communication cable, do not allow conduit to deflect vertically or horizontally along its length by a ratio greater than 10:1, (e.g. no more than 4-inch deflection per 40 inch in length).
- C. When installing conduit, do not allow the sum total of the vertical and horizontal deflection of conduit between any two junction boxes exceed 270 degrees.
- D. Do not place conduit directly above parallel utilities.
- E. Locate conduit within 1 ft of existing parallel conduit run if the planned location of conduit is parallel to the existing traffic signal or ATMS conduit. Refer to Section 02892.
- F. Install all conduit bends to have a radius that is not less than 3 ft.
- G. Install conduits that cross-finished curbs and gutters, sidewalks, concrete flatwork, textured or decorative surfaces by boring, jacking, or drilling. Entirely replace any damaged section at no additional cost to the Department.
- H. Obtain appropriate permits before work commences.

- I. Conduit Stub
1. Install conduit in a junction box per Section 13554 to allow for the continuation of a conduit run. Type and number of conduits as shown on details.
 2. Extend conduit stub to 10 feet from the junction box in line with the conduit run as shown on the Plans and Details.
- J. Proof all conduits with an approved mandrel prior to installation of cabling and Mule Tape.
- K. Record longitudinal and depth GPS coordinates (x,y,z) of conduit according to Section 01721.
- L. Install Mule Tape in all empty conduit including all cells of multi-duct conduit.
1. Install plug with 1/4-inch hole for Mule Tape on each end of conduit.
 2. Leave 2 ft of Mule Tape outside of the plug and fasten securely to plug.
 3. Do not splice Mule Tape in conduit.
 - Mule Tape is sequentially numbered
 - Must be continuous between junction boxes
- M. Place all conduit that is encased in a structural member per current Uniform Building Code and/or as approved by the Engineer.
- N. Secure conduit on structures with standard galvanized iron conduit clamps using at least 5/16-inch diameter concrete expansion anchors at a maximum of 5 ft spacing.
- O. Use conduit expansion fittings at structure expansion joint crossings.
- P. Fill all new and existing conduit to less than 40 percent as per NEC.
- Q. Maximum spacing between junction boxes is as follows:
1. 1,000 ft for tangent surface street installations
 2. 3,000 ft for tangent highway installations
 3. Reduced maximum spacing horizontal or vertical deflection prevents the installation of cable within maximum tensile rating of the cable or location wire.
- R. Locator Wire:
1. Install #14 THHN solid green locator wire continuously in 1-inch conduit and bond to grounding rods within each junction box.
 2. Mount locator wire connection device to the sidewall of each junction box using a mounting rail (Refer to Section 13554).

3. Connect the locator wire to the terminal block and connect the terminal block to the ground rod.

3.2 TRENCH FOR ATMS CONDUIT

- A. Paved Surface (asphalt concrete):
 1. Saw cut (Refer to 02705) roadway-to-roadway base on both sides of trench to provide clean, straight wall for T-patch prior to any backhoe use per Section 02705.
 2. Use flowable fill to within 3 1/2 inches to 6 inches of the existing roadway surface, depending on the existing pavement thickness.
 3. Minimum soil compaction under pavement: 96 percent.
 4. Evenly apply tack coat before final backfill.
 5. Restoration patch: match the composition, density, and elevation (1/4 inch), of the existing surface per Section 02741.
- B. Sidewalk or Decorative Pavement.
 1. Use flowable fill to within 3 1/2 inches to 6 inches of the existing roadway surface, depending on the existing pavement thickness.
 2. Minimum soil compaction under pavement: 96 percent.
 3. Restore sidewalk or decorative pavement to original condition or better after work is completed per Section 02776.
- C. Unpaved Surface:
 1. Use backfill that matches the composition, density, and elevation (± 0.2 inch), of the existing surface per Section 02776.
 2. Dispose of surplus material daily.
 3. Use flowable fill from bottom of trench to 3" above top conduit.
- D. Conduit under Railroad Right-of-Way: Refer to Section 00725 and appropriate railroad, such as Union Pacific Railroad, Standard Specifications:
 1. Coordinate all work with appropriate Railroad personnel.
 2. Complete Railroad Safety Training.
- E. Minimum cover of conduit:
 1. Minimum cover in sidewalks or paved surfaces: 3 ft.
 2. Minimum cover in highway right of way, greater than 20 ft from the edge of the pavement: 3 ft.
 3. Minimum cover within 20 ft of the edge of the pavement: 5 ft.
- F. Warning Tape:
 1. Install orange warning tape with black legend CAUTION - BURIED COMMUNICATION CABLE in all trenches containing multi-duct conduit or conduit containing communication cables.

2. Install red warning tape with black legend CAUTION - BURIED ELECTRIC in all other trenches.
3. Not required when flowable fill is directly overlaid with asphalt pavement or PCCP.
4. Not required when boring conduit.

3.3 ATMS CONDUIT IN TRENCH

- A. Place all conduits in the same trench whenever possible.
- B. Above ground use galvanized rigid steel; underground use PVC or HDPE. Apply corrosion protection per NEC Article 346 to any portion of galvanized rigid steel conduit buried in the ground or encased in concrete.
- C. If flowable fill is used, encapsulate conduit a minimum of 3 inches above the top conduit with flowable fill. Continue flowable fill to the wall of the junction box to seal conduit entry into junction box. Clean excess flowable fill from inside junction box.
- D. Install all conduits so the flowable fill completely surrounds all exterior surfaces of the conduit. Separate multi-duct conduits using a commercially available conduit spacer or approved equivalent.
- E. Install a bushing or adapter at ends of all nonmetallic conduit that contains a conductor per NEC Article 346, to protect the conductor from abrasion. Install rounded bushings on the ends of metal conduits per NEC Article 347.
- F. Install manufactured sweeps in the multi-conduit (11 1/4, 22 1/2, 45, 90 degree angle) with conduit compatible bell and spigot ends. Do not field bend conduit.
- G. Prior to pouring flowable fill, anchor the conduit in trench, at 16 ft intervals, to maintain the required conduit depth during pour.
- H. Minimum separation between all conduit is 1.5 inches. The separation between individual conduit within a single cluster of multi-duct conduit is permitted to be closer.
- I. Minimum separation between all conduit and the wall of the trench is 1.5 inches.
- J. Place the locator wire conduit on the plane of the uppermost conduit in the trench. The separation between the locator wire conduit and other conduit may be less than 1.5 inches.

- K. In native earth, do not place flowable fill closer than 6 inches to the finished grade.

3.4 ATMS CONDUIT IN DIRECTIONAL BORE OR PLOW

- A. Obtain approval from the Department on conduit splice connectors prior to use.
- B. Follow all requirements for ATMS Conduit in Trench per this section, Article 3.3 at all conduit splice locations not requiring junction boxes.

3.5 USE OF EXISTING OR OCCUPIED CONDUIT

- A. Maintain the physical condition and functional integrity of all cabling and wiring in existing or occupied conduit.
- B. Prior to installing fiber optic cable in an existing or occupied conduit:
 - 1. Remove any existing fiber optic cable/copper wire.
 - 2. Test the integrity and clean the conduit by successfully pulling a Department approved mandrel through the conduit prior to installing cable.
 - 3. Re-pull new and existing fiber optic cable/copper wire together.
 - 4. Perform all necessary splices and replace any impacted fiber cable, spider fan-out kits, and locate wire.
 - 5. Perform all additional necessary work needed to restore existing cable and conduit systems.

3.6 REPAIR/RESTORATION

- A. Restore all areas, including landscaping, concrete pavement, asphalt, finished curbs and gutters, box culverts, sewers, underground water mains, sprinkler systems, sidewalks, concrete flatwork, textured or decorative surfaces, that were damaged during conduit and junction box installation.
- B. Coordinate with local utilities for utility repair. Advise the Engineer of all repairs.

END OF SECTION

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Section 13554

POLYMER CONCRETE JUNCTION BOX

Delete Section 13554 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install polymer concrete junction box, ground rod, and maintenance marker. Includes Type I, Type II, and Type III Polymer-Concrete junction boxes.

1.2 RELATED SECTIONS

- A. Section 02056: Common Fill
- B. Section 02061: Select Aggregate
- C. Section 02842: Delineators
- D. Section 02892: Traffic Signal
- E. Section 03055: Portland Cement Concrete
- F. Section 13551: General ATMS Requirements

1.3 REFERENCES

- A. ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cubes)
- B. ASTM C 496: Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
- C. ASTM C 579: Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes

- D. ASTM C 580: Standard Test Methods for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
- E. ASTM C 1028: Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull Meter Method
- F. ASTM D 543: Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
- G. ASTM D 570: Standard Test Method for Water Absorption of Plastics
- H. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastic in a Horizontal Position
- I. ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Insulating Materials
- J. ASTM G 154: Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
- K. ANSI/UL 467: Grounding and Bonding Equipment

PART 2 PRODUCTS

2.1 MATERIALS

- A. Provide special termination kits from the conduit manufacturer for terminating the conduit in junction boxes. Provide kits that form a watertight seal of conduit to structure wall or grout around the conduit. Finish grout smooth and flush with the interior wall.
- B. Use free draining granular backfill borrow per Section 02061.
- C. Use granular backfill borrow per Section 02056.
- D. Provide maintenance markers for junction boxes along freeways and expressways.
- E. Provide concrete AA(AE) for concrete collar (Refer to Section 03055).

- F. Provide pre-cast polymer concrete junction boxes per the size and type specified in the plans. Boxes are made from polymer concrete.
- G. Use body, ring, and lid meeting the physical and chemical requirements listed in Table 1:

Table 1

Property	ASTM Test	Value
Compressive Strength	C 109	11,000 psi
Flexural Strength	D 790	7500 psi
Tensile Strength	C 496	1700 psi
Effects of Acids	D 543	Very Resistant
Effects of Alkalies	D 543	Very Resistant

- H. Provide all components with ultraviolet inhibitors per ASTM G 154.
- I. Provide all components flame-resistant per ASTM D 635.

2.2 JUNCTION BOXES AND LIDS

- A. Provide junction boxes and vaults that resist water absorption in accordance with ASTM D 570.
- B. “Load Rating 3” for Non Wheel Loading Accessible, Behind Sidewalk
 - 1. In area behind sidewalk, provide boxes, rings, and lids that sustain a minimum vertical test load of 12,000 lbs over a 10-inch x 10-inch square.
- C. “Load Rating 2” for Incidental Vehicular Traffic:
 - 1. In area not in traveled way, provide boxes, rings, and lids that sustain a minimum vertical test load of 22,500 lbs over a 10-inch x 20-inch square.
 - 2. Provide concrete collar per AT series Standard Drawings for all boxes that may experience incidental traffic.
- D. “Load Rating 1” for Deliberate Vehicular Traffic:
 - 1. In any paved area immediately adjacent to the mainline, such as shoulders, snow storage areas, or vehicle pullout areas, provide boxes, rings, and lids that sustain a minimum vertical test load of 45,000 lbs over a 10-inch x 20-inch square.
- E. Provide a poured-in-place 1-inch thick grout floor, with a 1-inch diameter drain, for all type I, II, and III-Polymer Concrete Junction Boxes or a box with a

prefabricated floor with a 1-inch drain hole. Refer to ASTM C 579 and ASTM C 580 for test methods for grout.

- F. Provide lid for all junction boxes as specified by application.
- G. Provide lids with a non-skid surface with minimum coefficient of friction of 0.50, per ASTM C 1028. Coatings will not be approved.
- H. Manufacture lids with the following markings in the logo area, in 1-inch recessed letters:
 - 1. "Traffic Signal" when the junction box contains cables or wires for traffic signal (Refer to Section 02892), CCTV, VMS, RWIS, WIM, ramp meter, traffic monitoring, or any other ATMS element (Refer to Section 13551).
 - 2. "Electric" when the junction box contains power conductors used for traffic signal, CCTV, VMS, RWIS, WIM, ramp meter, traffic monitoring, or any other ATMS element.
 - 3. "Street Lighting" when the junction box contains street lighting conductors only. Inscribe "High Voltage" below the words "Street Lighting" when the junction box contains voltage above 600 V.
 - 4. "Communication" when the junction box contains multi-duct conduit for future use.
 - 5. "Sprinkler Control" when sprinkler control conduit enters the junction box.
- I. Provide lids with recessed access point to allow removal of cover with a hook or lever. Damage to the pulling point in the lid must be repaired.
- J. Provide lids with vandal-resistant stainless steel recessed bolts.

2.3 MAINTENANCE MARKERS

- A. Steel posts: Refer to Section 02842.

2.4 BACKFILL

- A. Compact free draining granular backfill borrow under junction boxes. Refer to Section 02061.
- B. Compact granular backfill borrow around boxes. Refer to Section 02056.

2.5 CONDUIT PLUGS

- A. Use conduit plugs that have been specifically designed to seal the sized conduit used and that the Mule Tape can be securely fastened to.

2.6 GROUND ROD

- A. Copper-coated steel as specified.
- B. ANSI/UL 467

2.7 GROUND WIRE

- A. Refer to Section 13551.

PART 3 EXECUTION

3.1 JUNCTION BOX AND EXTENSION

- A. Install per manufacturer's recommendations.
- B. Cast conduit holes in junction box at the time of precasting or drill at the time of placement with no structural damage to the box.
 - 1. Holes drilled in junction box must not be more than ¼-inch larger than conduit diameter.
 - 2. Seal conduit ends inside all junction boxes with at least 2-inch thick duct caulking after wires are installed.
 - 3. Seal vacant conduit with a manufactured plug designed for that purpose.
- C. Place the top of the junction box flush with the surrounding grade or set at the planned finished grade.
- D. Hand tamp the granular backfill borrow material around the junction box. Match the top 4 inches to the composition, density, and elevation of the surrounding surface.
- E. Do not install junction boxes inside of railroad right of way.
- F. Field locate junction boxes to avoid steep slopes and low lying locations with poor drainage.

- G. Do not install junction boxes within the traveled way, shoulders, or on approaches to signal poles.
- H. Do not install conduit in corner of junction box, or within 2 inches of corner of junction box. Extend multi-duct conduit 6 inches (nominal) beyond the inside wall of the junction box. Extend all other non-multiduct conduit 2 inches minimum to 3 inches maximum beyond the inside wall of the junction box. Refer to AT series Standard Drawings.
- I. Enter conduit through the sides of the junction box and not from the bottom. Place the conduit at least two inches above the floor.
- J. Orient the recessed access point in a location that provides both leverage and safety.
- K. Saw cut concrete or other improved surfaces that require removal in the sidewalk area. Remove entire section of sidewalk. Replace with in-kind materials to match the existing grade.
- L. Provide 12 inches deep free draining granular backfill borrow directly under junction box.
- M. Install expansion joint material around entire periphery of ring for junction boxes installed in paved surface.
- N. Record GPS coordinates for all junction boxes according to Section 13551.

3.2 CONCRETE COLLAR

- A. See AT series Standard Drawings
- B. Concrete: AA(AE) Refer to Section 03055.
- C. Do not install concrete collar for junction boxes in paved surface. Install concrete collars in all other areas.

3.3 GROUND ROD

- A. Install ground rod to extend maximum 2 inches above box floor.
- B. Attach ground wire or locator wire with clamps.

3.4 RESTORATION

- A. Restore all areas damaged during the installation of the junction boxes.

END OF SECTION

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Section 13555

ATMS CABINET

Delete Section 13555 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install or modify concrete foundations of the size and type as specified in the plans.
- B. Install state furnished ATMS Cabinet. Includes all materials, labor, workmanship, equipment, documentation, and incidental items required to provide a complete and operational ATMS Cabinet as shown on plans and details.

1.2 RELATED SECTIONS

- A. Section 02892: Traffic Signal
- B. Section 03055: Portland Cement Concrete
- C. Section 03152: Concrete Joint Control
- D. Section 03211: Reinforcing Steel and Welded Wire.
- E. Section 13551: General ATMS Requirements
- F. Section 13553: ATMS Conduit
- G. Section 13554: Polymer Concrete Junction Box
- H. Section 13561: ATMS Power Service

1.3 REFERENCES

- A. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- B. ASTM A 307: Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- C. ASTM B 766: Standard Specification for Electro-deposited Coatings of Cadmium
- D. National Electrical Manufacturers Association (NEMA) Standards

1.4 SUBMITTALS

- A. Submit samples of materials for approval when requested.
- B. Provide the following submittals as described in Section 13551:
 - 1. Contractor Furnished Material and Equipment Lists
 - 2. Manufacturer's Equipment Documentation

PART 2 PRODUCTS

2.1 CABINET FOUNDATION

- A. Concrete: A(AE) required. Refer to Section 03055.

2.2 BOLTS, NUTS, AND HARDWARE

- A. For cabinet mounts, provide wedge expansion type, or poured in place anchor bolts.
 - 1. 3/4 inch x 8-inch expansion anchor bolts.
 - 2. 9000 lbs pullout strength.
- B. Provide commercially available framing strut to attach transformers, breaker enclosures, disconnects, or other electrical equipment to cabinet foundation.
 - 1. 12-gauge, U-shaped stainless steel product with 5/8-inch diameter pre-drilled holes.
 - 2. Cross-section dimensions: 1 5/8 inch x 1 5/8 inch minimum.

- C. For framing struts, provide wedge expansion anchor bolts to secure framing strut to foundation.
 - 1. 1/2 inch x 8-inch embedded a minimum of 6 inches in foundation.
 - 2. Shear capacity of 2500 lbs and pullout tension capacity of 2600 lbs.
- D. Provide stainless steel, galvanized, or zinc plated bolts, nuts, washers, struts, and hardware, as specified.
 - 1. Steel as specified (ASTM A 307).
 - 2. Galvanized as specified (ASTM A 123).
 - 3. Zinc plated as specified (ASTM B 766).
- E. Provide nuts that are free running, by hand, for total thread length.
- F. Provide all bolted connections with lock washers, locking nuts, or other approved means to prevent the connection nuts from backing off.
- G. Provide nipples, elbows, and grommets necessary for wiring.

2.3 CONDUIT

- A. Refer to Section 13553
- B. Refer to Section 02892

2.4 JUNCTION BOX AND GROUND ROD

- A. Refer to Section 13554

2.5 POWER SOURCE

- A. Refer to Section 13561

2.6 TRANSFORMER AND DISCONNECT

- A. Submit specifications for approval.

2.7 BITUMINOUS JOINT FILLER

- A. Preformed material. Refer to Section 03152

PART 3 EXECUTION

3.1 PREPARATION

- A. Use maintenance platforms when surrounding area is not paved. Platforms provide access to the cabinets for maintenance activities. Locate cabinet in an area where full access is allowed.
- B. Repair any damage to existing utilities.
- C. Restore area to the condition prior to beginning work.
- D. Field locate cabinet location with the Engineer. Avoid areas with poor drainage. Satisfy clear zone requirements.

3.2 CONSTRUCT CABINET FOUNDATION

- A. Reinforcing Steel and Welded Wire. Refer to Section 03211
- B. Verify bolt pattern, conduit runs, and foundation dimensions prior to foundation construction.
 - 1. Orient anchor bolts to accommodate conduit runs.
 - 2. Embed strut anchor bolts a minimum of 6 inches into foundation.
 - 3. Embed cabinet anchor bolts a minimum of 6 inches into foundation.
- C. Concrete: A(AE) required. Refer to Section 03055
- D. Do not weld reinforcing steel, conduit, or anchor bolts.
 - 1. Use tie wire to secure conduits.
 - 2. Use template to align and secure anchor bolts.
 - 3. Locate steel, conduit, or anchor bolts a minimum of 3 inches from concrete edge.
- E. Place the concrete directly into the excavation. Use minimum forming above ground.
- F. Provide 36 inches minimum clearance between foundation and all walls, guardrails, poles, and other aboveground features.
- G. Do not extend conduit stubs in cabinet more than 3 inches above floor of foundation.

- H. Conduit
1. Install all conduit in base of cabinet in a 12-inch x 18-inch rectangle centered in the cabinet base.
 2. Refer to the Project Plans for the number, size, and orientation of all conduits entering the junction boxes.
 3. Conduit (typical) for power from cabinet with disconnect to Type I junction box:
 - a. One-1 1/2 inch from cabinet to disconnect.
 - b. One-1 1/2 inch from disconnect to Type I junction box.
 4. Conduit (typical) for power from cabinet with disconnect/step-down transformer to Type I junction box:
 - a. One-2 inch from disconnect to Type I junction box
 - b. One-1 1/2 inch from disconnect to transformer
 - c. One-1 1/2 inch from transformer to cabinet
 5. Conduit (typical) for communication from cabinet to Type II junction box:
 - a. Two-3 inch
 - b. Four-2 inch
 6. Conduit (typical) for communication stubbed out of Type II junction box:
 - a. Two-3 inch
 - b. Four-2 inch
 - c. One-3 inch (used as a spare conduit)
 7. Above ground, use galvanized rigid steel; underground, use PVC.
 8. Install bushings on the ends of metallic conduit. Install end bells on non-metallic conduit.
 9. Provide 1 inch minimum spacing between conduit in cabinet base. Cap conduit at both ends until used. Stub conduit a maximum of 3 inches above the concrete base.
- I. Orient the cabinet to allow maintenance personnel facing the front door of the cabinet to also face the device (such as VMS, CCTV, RMS, TMS). Orient the cabinet such that the door that accesses the front face of the control equipment is adjacent to the Type II-PC junction box.
- J. Trowel finish the foundation surface and level prior to cabinet installation. After the concrete base has cured, leveling can only be accomplished by grinding the top surface.
- K. Bituminous filler at concrete joints. Refer to Section 03152

3.3 INSTALL ATMS CABINET

- A. Securely fasten the cabinet onto the concrete foundation. After the cabinet has been installed on the foundation, the cabinet door must be able to fully open and close.

- B. Provide a rain-tight seal that does not degrade the NEMA 3R (See NEMA Standards Publication 250-1997) rating of the enclosure for all conduit fittings and chases to adjoining enclosures.
- C. Isolate dissimilar materials from one another by stainless steel fittings.
- D. Make all power connections as shown in plans.
 - 1. Isolate the neutral bus from the cabinet and equipment ground.
 - 2. Terminate the neutral bus at the neutral lug attached to the meter pedestal.
- E. Install caulk between base of cabinet and top of foundation.

3.4 INSTALL DISCONNECT AND/OR TRANSFORMER

- A. Install 12 gauge framing strut to the foundation with 3 expansion anchors per super strut.
- B. Install disconnect and transformer on the side of the foundation that faces away from the nearest traffic. If wall blocks access to the disconnect, then install the disconnect and transformer on the opposite side of cabinet.
- C. Ground disconnect on ground rod located in Type I junction box.
- D. Ground the transformer to the control cabinet ground terminal.
- E. Install disconnect and/or transformer per manufacturer's instructions.
- F. Install 5/8-inch spacers on each expansion anchor between foundation and disconnect.

3.5 INSTALL WIRING

- A. Refer to Section 13551.
- B. Clamp the ground wire from the cabinet ground to the ground rod in the Type II junction box.
- C. Terminate all terminal connections by a mechanical (spade) connector.
- D. Identify and label all field terminals and cables.

3.6 INSTALL POWER SOURCE

- A. Verify the exact location, voltage, procedure, and materials required by the power company.
- B. Follow SL series Standard Drawings.

END OF SECTION

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Section 13556

CLOSED CIRCUIT TELEVISION (CCTV) ASSEMBLY

Delete Section 13556 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Includes all materials, labor, workmanship, equipment, testing, documentation, and incidental items required to install and test a complete and operational Freeway CCTV system as shown on plans and details.
- B. Install state furnished CCTV pole with foundation and anchor bolts, furnish and install junction box at the base of the pole with ground rods, ground wire, and all other incidental hardware. Includes Contractor furnished CCTV Cable, and all other conduit and junction boxes required to provide a path from the CCTV pole to the control cabinet.
- C. Furnish and install wood CCTV pole.
- D. Install state furnished freeway CCTV assembly with pan/tilt unit, camera control receiver, and pole-mounted cabinet.

1.2 RELATED SECTIONS

- A. Section 02892: Traffic Signal
- B. Section 03055: Portland Cement Concrete
- C. Section 03310: Structural Concrete
- D. Section 13551: General ATMS Requirements
- E. Section 13553: ATMS Conduit

- F. Section 13554: Polymer Concrete Junction Box
- G. Section 13555: ATMS Cabinet
- H. Section 13595: ATMS Integration

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- B. AASHTO M 111: Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products
- C. AASHTO M 270 Grade 36: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
- D. AASHTO M 284: Epoxy Coated Reinforcing Bars
- E. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Highway Bridges
- F. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- G. AASHTO Division II Section 5
- H. AASHTO's Standard Specifications for Highway Bridges
- I. ASTM A 36: Standard Specification for Carbon Structural Steel
- J. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron or Steel Products
- K. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- L. ASTM A 307: Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- M. Electronic Industries Association (EIA) Standards

- N. International Municipal Signal Association (IMSA) Specifications
- O. National Electric Code (NEC)

1.4 SUBMITTALS

- A. Provide all of the following submittals as described in Section 13551:
 - 1. Contractor Furnished Material and Equipment Lists
 - 2. Test Reports for the Cable & Conductor Test, the Local Field Operations Test, and the Thirty-Day Burn-In Test
 - 3. Completion Notice
 - 4. Manufacturer's Equipment Documentation
 - 5. As-Built Drawings

PART 2 PRODUCTS

2.1 CCTV POLE OR LUMINAIRE

- A. Wood Pole Mounted CCTV: provide class 5 or 6 Douglas Fir wood pole, treated with Chromated Copper Arsenate CCA Type C, 33 ft nominal length and not less than 5 1/2 inches diameter at top.
- B. Steel Pole Mounted CCTV: steel pole with anchor bolts provided by the Department. Refer to ASTM A 36.
 - 1. Anchor bolts: conform to AASHTO M 270 Grade 36.
 - 2. Nuts, washers, and anchor bolts: galvanized according to ASTM A 153 and ASTM A 123.
- C. Luminaire Mast Arm Mounted CCTV: provide luminaire extension per Section 02892 and SL series Standard Drawings.

2.2 CCTV STEEL POLE FOUNDATION

- A. Class AA(AE) concrete. See Section 03055 and Section 03310.
- B. Reinforcing Steel
 - 1. Coated.
 - 2. AASHTO M 284 or M 111
 - 3. AASHTO M 31 Grade 400
- C. Non-Shrink Grout.

2.3 JUNCTION BOX

- A. Refer to Section 13554.

2.4 CCTV ASSEMBLY

- A. Department furnished:
 - 1. Camera assembly, including camera, pan/tilt unit, control receiver, environmental enclosure, and cabling.
 - 2. Type G pole-mount cabinet.

2.5 MOUNTING EQUIPMENT

- A. Provide clamp kit, mounting hardware, pipe, shims, grommet, and all additional equipment to attach CCTV assembly to pole or mast arm.
- B. Provide all stainless steel or hot-dipped galvanized fasteners and hardware unless otherwise approved. Provide copper pole grounding lug.

2.6 DATA SURGE SUPPRESSOR

- A. General characteristics (typical):
 - 1. Typical application: RS-422.
 - 2. Surge: 36 kA.
 - 3. Turn-on at 10 mA: +2.8/-0.6 V dc.
 - 4. Resistance: 1 Ohm.
 - 5. Capacitance: 30 pF.
 - 6. Energy: 310 ft-lbs
 - 7. Let-through: less than +10/-1 Vp (peak open circuit voltage at max current).
 - 8. -3dB (600 Ohms) BW: 95Mhz
 - 9. Temperature: -40 degrees F to 185 degrees F Storage/Operating 122 degrees F.

2.7 VIDEO SURGE SUPPRESSOR

- A. General characteristics (typical):
 - 1. Typical application: VLF/HF receive only, LAN, closed circuit video.
 - 2. Surge: 18 kA IEC 1000-4-5 8/20 ms waveform 80 ft-lbs.
 - 3. Turn-on Time: 4 ns for 2 kV/ns.
 - 4. VSWR: less than or equal to 1.1 to 1 over frequency range.

5. Insertion Loss: less than or equal to 0.3 dB over frequency range.
6. User Current: 2.0A dc continuous.
7. Vibration: 1G up to 100Hz.
8. Temperature: -50 degrees F to 185 degrees F Storage/Operating
113 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.
- B. Provide foundation, junction boxes, ground rod, grounding lug, conduit, stainless steel mounting bands, wood pole, and all additional equipment required for a complete and operational CCTV system.
- C. Install all wiring, conduit, and junction boxes as shown on site plans and details.
 1. Field locate all conduits per Section 13553 and junction boxes to avoid drainage areas and steep slopes whenever possible.
 2. Protect existing conductors while installing camera cables and conductors.
- D. Connect the controller and all wires as specified by the manufacturer.
- E. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the CCTV system complete.
- F. After installation, the exterior of all equipment must be free of all loose rust and mill scale, dirt, oil, grease and other foreign substances.

3.2 STEEL CCTV POLE FOUNDATION

- A. All material and workmanship conforms to AASHTO's Standard Specifications for Highway Bridges.
- B. Verify that the installation of the CCTV camera, pole, pole mount cabinet, junction boxes, and foundation in the location marked in the field has no conflict with existing utilities, underground and overhead. Comply with all utility and blue stake requirements.
- C. Excavation
 1. Refer to Section 13551.

- D. Caissons conform to AASHTO Division II Section 5, Drilled Piles and Shafts. Drill caissons into either native soil or compacted fill.
 - 1. If formwork is required during drilling, the forms may be withdrawn during concrete placement.
 - 2. Cast the top of the caisson against the formwork for appearance.
- E. Place concrete directly into the excavation. Use minimum forming.
- F. Do not weld reinforcing steel, conduit, or anchor bolts; tie reinforcing steel and conduit securely in place.
- G. Coat all reinforcing steel to conform to AASHTO M 284 or M 111 and AASHTO M 31 Grade 420, respectively. Coat the ends of cut reinforcing with approved coating.
- H. All cast-in-place concrete will be class AA(AE) except where specified otherwise. Cap all conduits before placing concrete.
- I. After pole is installed, place non-shrink grout between base plate and foundation surface.
- J. Install weep hole in foundation per SL series Standard Drawings.

3.3 ANCHOR BOLTS

- A. Refer to ASTM A 307 and Section 13551.

3.4 STEEL CCTV POLE

- A. Install the metal camera poles on concrete bases as described herein. Apply rust, corrosion, and anti-seize protection at all threaded assemblies by coating the mating surfaces with an approved compound. Refer to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Highway Bridges, as well as AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
- B. Install pole such that the hand hole is facing away from traffic.
- C. Install ground rod. NEC 250.1.
- D. All fasteners and attachment hardware for bands and other equipment: stainless steel.

- E. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, electrical nuts, etc., necessary to make the CCTV system complete.
- F. Adjusting the anchor bolt nuts, plumb all steel poles to the vertical with all camera equipment installed.
- G. Pole Mount Cabinet
 - 1. The Department rejects poles that are damaged by improper drilling of holes.
 - 2. Drill and nipple holes at each site.
 - 3. Touch-up by hot stick method.

3.5 WOOD CCTV POLE

- A. Install wood pole below grade to a minimum depth equal to one-sixth the total pole height. Refer to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.
- B. Increase the installation depth by 1 times the diameter of the pole when wood pole is installed on a slope of 2:1 or greater. Measure depth from the down-slope side of the pole.
- C. Backfill with native material in 1 foot lifts to match surrounding grade. Tamp each lift to 90 percent compaction.

3.6 CCTV ASSEMBLY

- A. Assemble the camera assembly and prepare for installation per the manufacturer's instructions prior to delivery to the job site.
- B. Deliver the assemblies to the job site as complete units, and install as per the plan details.

3.7 CCTV CABLES

- A. Install camera cables in conduit and poles. All cable runs must be continuous and must run without splices between the camera and the cabinet.
- B. Keep cable ends sealed at all times during installation using an approved cable end cap. Keep cable end sealed until connectors are installed.

- C. Do not violate the minimum bending radius and the maximum pulling tension recommended by the manufacturer's specifications at any time.
- D. Provide 6 ft of cable slack in all cabinets. Refer to Section 13555.
- E. Make all camera cable connections between the CCTV assembly, RS-422/RS-232 converter, and communications equipment, as required to provide a fully operational CCTV system.

3.8 CONDUCTORS

- A. Dome CCTV: furnish and install 3-#12 stranded IMSA Spec 20-1 power conductor cables between the 24 VAC transformer in the cabinet and the cabinet assembly on the luminaire arm.
- B. Freeway CCTV: furnish and install 3-#6 from camera assembly to cabinet.
- C. Freeway CCTV with Pole Mounted Cabinet: furnish and install 3-#12 from camera assembly to cabinet.
- D. Splices: not allowed between camera and cabinet.

3.9 POLE-MOUNTED CABINET

- A. Install cabinet such that cables enter the underside of the cabinet.
- B. Arrange all equipment installed in the cabinet in a neat and orderly fashion on shelf. Refer to Section 13555.
- C. Install pole mounted cabinet such that it faces away from traffic. Use stainless steel bands.

3.10 JUNCTION BOX

- A. Refer to Section 13554.

3.11 TESTING AND ACCEPTANCE

- A. Successfully complete the following tests:
 - 1. Cable and Conductor Test: Refer to Section 13551.

2. Local Field Operations Test: Use the Closed Circuit Television (CCTV) Local Field Operations Test form Instruction. Obtain UDOT's newest version of the form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
 - a. Conduct the test after the Cable and Conductor test has been successfully completed and the Cable and Conductor Test Report has been approved by the Engineer.
 - b. Furnish all equipment, material, and labor necessary for the test.
3. Acceptance Tests: Refer to Section 13595.

END OF SECTION

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Section 13557

VARIABLE MESSAGE SIGN

Delete Section 13557 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Install all Department furnished items including VMS sign assembly, VMS cabinet, and controller.
- B. Furnish, install, and test VMS tubular support structures, VMS sign assembly, sign connection hardware, catwalk, cabinet foundation, communications cable and any additional equipment required. Contractor will furnish all incidental items required to provide a complete cable connection between VMS controllers as shown in the details and specifications. Test the installed VMS and adjust the viewing angle as required.

1.2 RELATED SECTIONS

- A. Section 01554: Traffic Control
- B. Section 02466: Drilled Caisson
- C. Section 02841: W-Beam Guardrail
- D. Section 02843: Crash Cushions
- E. Section 02844: Concrete Barrier
- F. Section 03055: Portland Cement Concrete
- G. Section 03152: Concrete Joint Control
- H. Section 03211: Reinforcing Steel and Welded Wire

- I. Section 03310: Structural Concrete
- J. Section 05120: Structural Steel
- K. Section 13551: General ATMS Requirements
- L. Section 13553: ATMS Conduit
- M. Section 13554: Polymer Concrete Junction Box
- N. Section 13555: ATMS Cabinet
- O. Section 13595: ATMS Integration

1.3 REFERENCES

- A. AASHTO M 31: Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- B. AASHTO M 111: Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- C. AASHTO M 232: Zinc (Hot-dip Galvanized) on Iron and Steel Hardware
- D. AASHTO M 270: Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched and Tempered Alloy Structural Steel Plates for Bridges
- E. AASHTO M 284: Epoxy Coated Reinforcing Bar
- F. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- G. ASTM A 36: Carbon Structured Steel
- H. ASTM A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- I. ASTM A 123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- J. ASTM A 153: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Hardware (nuts, washers, and anchor bolts)
- K. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

- L. ASTM A 325: Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- M. ASTM A 563: Carbon and Alloy Steel Nuts
- N. ASTM B 766: Cadmium Coatings on Iron, Steel, and Other Metals
- O. ASTM F 436: Hardened Steel Washers
- P. ASTM F 593: Stainless Steel Bolts, Hex Cap Screws, and Studs
- Q. ANSI/AASHTO/AWS D1.5: Welding Specifications

1.4 SUBMITTALS

- A. Mill Certificates for all structural steel. Refer to Section 05120.
- B. Shop Drawings for all structure steel. Refer to Section 05120.
- C. Provide all of the following submittals as described in Section 13551:
 - 1. Contractor Furnished Material and Equipment Lists
 - 2. Test Reports for the Cable & Conductor Test, the Local Field Operations Test, and the Thirty-Day Burn-In Test
 - 3. Completion Notice
 - 4. Compliance Certificate
 - 5. Manufacturer's Equipment Documentation
 - 6. As-Built Drawings

PART 2 PRODUCTS

2.1 VMS FOUNDATIONS

- A. Concrete: Class AA(AE) required. Refer to Sections 03055 and 03310.
- B. Reinforcing Steel: Refer to Section 03211
 - 1. Deformed billet-steel bars conforming to AASHTO M 284 and M 31 (Grade 60) respectively.
 - 2. Coated
 - 3. Use #5 spiral reinforcing steel conforming to AASHTO M 31 except minimum tensile strength of 58,000 psi.
- C. Anchor Bolts:
 - 1. Conform to AASHTO M 270 Grade 36 and ASTM A 307 Specifications.

2. Thread and galvanize the upper 12-inch: free running nuts, by hand, for the entire length of the threads.
3. Galvanize the upper 14 inches of the anchor bolts, all nuts and washers, in accordance with the requirements of AASHTO M 232.
4. Hook dimension of 8 inch as shown in Standard Plans.
5. Do not weld anchor bolts to reinforcing steel.
6. Nuts: Conform to ASTM A 563 Specifications.
7. Washers: Conform to ASTM F 436 Specifications.

2.2 BITUMOUS JOINT FILLER

- A. Preformed material: Refer to Section 03152.

2.3 JUNCTION BOX

- A. Refer to section 13554.

2.4 VMS SUPPORTS

- A. Structural Steel: General
1. Hot dip galvanize all structural steel after fabrication in accordance with AASHTO M 111. Structural steel may be metallized using electric arc sprayed zinc wire as an alternative.
 2. Welding design and fabrication: In accordance with the ANSI/AASHTO/AWS D1.5 Specifications.
 3. Use galvanized bolts, nuts, and washers in conformance with AASHTO M 232. Lock washers required on all bolts.
- B. Structural Tubing:
1. Use low carbon steel conforming to ASTM A 53 Grade B, except use chemical composition requirements of: carbon 0.25 percent, phosphorus 0.04 percent, manganese 1.35 percent, and silicon 0.05 percent. Conform to ASTM A 53 Grade B for other elements.
 2. Bolts: Conform to ASTM A 325 Specifications.
 3. Nuts: Conform to ASTM A 563 DH Specifications.
 4. Washers: Conform to ASTM F 436 Specifications. Lock washer: all bolts.
 5. Galvanize bolts, nuts, washers: AASHTO M 232.
- C. All Other Structural Steel:
1. All other shapes and plates: Conform to AASHTO M 270 Grade 36.
 2. Bolts: Conform to ASTM A 307 Specifications.
 3. Stainless Steel Bolts: Conform to ASTM F 593 Type 304 Specifications.
 4. Nuts: Conform to ASTM A 563 Specifications.

5. Washers: Conform to ASTM F 436 Specifications. Use lock washers on all bolts.
 6. Galvanize bolts, nuts, washers: AASHTO M 232.
 7. Entire sign assembly with mounting brackets: Galvanize to AASHTO M 111.
- D. Welding design and fabrication: ANSI/AASHTO/AWS D1.5 specifications.

PART 3 EXECUTION

3.1 PREPARATION

- A. Type I Sign Design Criteria
 1. Dead Load: 4800 lb.
 2. Live Load: 510 lb.
 3. 100 mph wind load.
 4. Snow and ice loadings.
- B. Load, transport, and install all state-furnished materials per the manufacturer's instructions and as shown in the plans.
- C. Provide foundation, VMS supports, junction boxes, ground rod, grounding lug, conduit, and all additional miscellaneous items required for a complete and operational VMS.
- D. Install all wiring, conduit, and junction boxes as shown on site plans and details.
 1. Field locate all conduit and junction boxes to avoid drainage areas and steep slopes whenever possible.
 2. Protect existing conductors while installing cables and conductors.
- E. Furnish and install all incidental items, such as wire nuts, grommets, tape connectors, and electrical nuts, necessary to make the VMS system complete.
- F. After installation, the exterior of all equipment must be free of all loose rust and mill scale, dirt, oil, grease and other foreign substances.
- G. Restore work area to the original condition or better after work is completed.

3.2 CONSTRUCTION SEQUENCE

- A. Deploy traffic control devices and/or personnel. Refer to Section 01554.
- B. Construct foundations, establishing base plate elevations in accordance with project plans.

- C. Determine design height of both vertical supports, and length of horizontal support based on the 'as-built' foundation field survey. Meet vertical clearance requirements during construction. Determine catwalk design dimensions based on survey data. Obtain Engineer's approval for all dimension changes.
- D. Fabricate structural supports and catwalk. Review shop-drawings and relate to survey information to assure consistency.
- E. Erect structure with sign.
- F. Remove shipping supports and connect all wiring and cables in a neat and orderly fashion, verify all parts are properly seated and functional and make final adjustments to sign horizontal and vertical angles. The Engineer reserves the right to order adjustments to the sign angle during the initial installation.

3.3 VMS FOUNDATIONS

- A. Excavation
 - 1. Perform as described in Section 13551.
- B. Anchor Bolts:
 - 1. Provide anchor bolt template during installation of anchor bolts. Fabricate the bolt template of 1/4-inch thick minimum steel plate, similar to anchor plate details. Match drill to each base plate.
- C. Earthwork
 - 1. Place compacted embankments prior to drilling.
 - 2. Drill caisson forms 6 inches minimum below ground surface. Refer to Section 02466. Place compacted backfill before erecting post.
- D. Bitumous filler at concrete joints. Refer to Section 03152.
- E. Barrier
 - 1. Locate all foundations and poles within traffic barriers per Sections 02841 and 02844 and/or Crash Cushions per Section 02843.

3.4 VMS SUPPORTS

- A. Structural Tubing:
 - 1. Provide hand holes for tubular overhead frame on one side only.
 - 2. Locate inserts at the bottom of the mast arm where shown on the Standard Plans. Weld 1 1/2-inch diameter insert in each hole. Thread inserts before galvanizing and provide galvanized plugs.
 - 3. Rack post as necessary during sign erection using leveling nuts to level the sign panels. At final position wrench tighten both top and bottom anchor bolt nuts against the base plate.
- B. All Other Structural Steel:
 - 1. Use one sign-mounting bracket at each sign Z bracket. See sign fabricator's drawings for number and location of Z brackets.
 - 2. Pre-tension steel rod to 11,000 lbs.
 - 3. During sign erection, rake post as necessary with the use of leveling nuts to make the variable message sign level. At final position wrench tighten both top and bottom anchor bolt nuts against base plate.
 - 4. Sign placement on horizontal member may be adjusted up to 3/8 inches upward for VMS platform to match catwalk elevation.
 - 5. Refer to ASTM A 36: Standard Specification for Carbon Structural Steel, and AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.
- C. Earthwork:
 - 1. Place and compact backfill prior to erecting supports.

3.5 VMS CABINET

- A. Cabinet Foundation
 - 1. Concrete: A(AE) required: Refer to Sections 03055 and 03310.
 - 2. Trowel finish and level top surfaces prior to cabinet installation. Level top surfaces of cured concrete by grinding.
- B. Bolts, Nuts, and Hardware
 - 1. Furnish and install 3/4-inch x 8-inch anchor bolts to secure cabinet. Cabinet anchor bolts: minimum pullout strength 11,000 lb.
 - 2. Expansion anchor bolts to secure framing strut to foundation: 1/2 inch diameter embedded 6-inch minimum in foundation, with shear capacity of 2500 lbs and tension (pullout) capacity of 2600 lbs. Locate expansion anchors a minimum of 3 inches from any edge of concrete.

3. Provide stainless steel, galvanized, or zinc plated bolts, nuts, and hardware.
 - a. Steel as specified. ASTM A 307.
 - b. Galvanized as specified. ASTM A 123 and ASTM A 153.
 - c. Zinc plated as specified. ASTM B 766.
4. Provide all bolted connections with lock washers, nuts, or other approved means to prevent the connection nuts from backing off.
5. For framing struts, provide commercially available 12-gauge, u-shaped stainless steel product with ½ inch diameter pre-drilled holes, to attach transformers, breaker enclosures, disconnects, or other electrical equipment to cabinet foundation. Provide strut with cross-section dimensions 1 7/16 inch x 1 7/16 inch minimum.
6. Verify bolt pattern and foundation dimensions prior to foundation construction.

C. Conduit

1. Install all conduit in base of cabinet in a 12-inch x 18-inch rectangle centered in the cabinet base. Conduit may be aligned in an alternate pattern than is shown in the plan. Refer to the plans for the number, size, and orientation of all conduits entering the junction boxes.
2. Conduit (typical) from cabinet to Type I junction box
 - One-1 1/2 inch from cabinet to disconnect
 - One-1 1/2 inch from disconnect to Type I junction box
3. Conduit (typical) from cabinet to Type II junction box
 - Two-3 inch
 - Four-2 inch
4. All exposed conduit: metallic.
5. Install bushings on metallic conduit ends at the top of concrete bases if wire or cable is installed. Install end bells on non-metallic conduit if wire or cable is installed.
6. Provide 1 inch minimum spacing between conduit in cabinet base. Cap conduit at both ends until used. Stub conduit 3 inches above the concrete base.
7. Refer to Section 13553.

- D. Orient the cabinet such that the front door is on the opposite side of the cabinet from the VMS to allow maintenance personnel facing the front door of the cabinet to also face the VMS. Orient the cabinet such that the door that accesses the front face of the control equipment is adjacent to the Type II junction box.

E. Disconnect and Transformer

1. Install struts as per Section 13555.
2. Install disconnect and transformer on the side of the cabinet that faces away from the nearest traffic. If wall blocks access to disconnect, then install the disconnect and transformer on the opposite side of the cabinet.

3. Install 0.67-inch spacers with each expansion anchor between the foundation and disconnect/transformer. Maintain a 0.67-inch gap between the disconnect/transformer and the foundation.
 4. Ground the transformer to the control cabinet ground terminal.
 5. Install disconnect and transformer per manufacturer's instructions.
- F. Identify all field terminals.
- G. Junction box installation. Refer to Section 13554.

3.6 TESTING AND ACCEPTANCE

- A. Successfully complete the following tests:
1. Cable and Conductor Test: Obtain UDOT's newest version of the ATMS Cable and Conductor Test from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
 2. Local Field Operations Test: Obtain UDOT's newest version of the Variable Message Sign Local Field Operations Test form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
 - a. Conduct the Local Field Operations test after the Cable and Conductor test has been successfully completed and the Cable and Conductor Test Report has been approved by the Engineer.
 - b. Verify physical construction has been completed in accordance with the plans and specifications and that the connecting cabling has been properly installed.
 - c. Furnish all equipment, appliances, and labor necessary for the test.
 3. Acceptance Tests: Refer to Section 13595.

END OF SECTION

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Section 13561

ATMS POWER SERVICE

Delete Section 13561 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install a complete electrical power service as shown in the Details and Specifications. Includes all coordination with the power service provider, wires, surge protection, rigid metal riser, weatherhead, transformer, disconnects, conduit risers and stand-off brackets, breakers, clamps, conduit, junction boxes, grounding materials, duct seal, pull wire, locate tape, labor, workmanship, equipment, testing, documentation, and incidental items required for a fully operational system.
- B. Furnish and install Power Pole.

1.2 RELATED SECTIONS

- A. Section 13551: General ATMS Requirements

1.3 REFERENCES

- A. AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
- B. ASTM A 123: Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- C. ASTM B 117: Operating Salt Spray (Fog) Apparatus
- D. Electrical Utility Service Equipment Requirements Committee (EUSERC)
- E. Local utility electric service requirements
- F. National Electrical Manufacturers Association (NEMA) Standards

- G. National Electric Code (NEC)
- H. Underwriters Laboratories (UL)

1.4 SUBMITTALS

- A. In accordance with Section 13551.

PART 2 PRODUCTS

2.1 GENERAL

- A. Comply with NEC regulations, local utility electric service requirements and standards, and Department standards for all electric service products.
- B. Provide approved underground service pedestal. Use a safety switch as indicated in SL series Standard Drawing for service pedestal. Service Enclosures must be NEMA 3R rated. Refer to NEMA Standards Publication 250-1997.
- C. Provide circuit breakers sized as indicated in plans.
- D. Provide riser and weatherhead in compliance with Department and local utility standards. Refer to SL series Standard Drawings.
- E. Provide approved blade disconnect as shown on plans and details.
- F. Provide MasterLock P848 Lock for all disconnects and service pedestals. Provide two keys per lock to the Engineer.
- G. Pole Mount: Refer to SL series Standard Drawings.
 - 1. Service disconnect according to plans.
 - 2. Provide a manual EUSERC approved circuit closing link by-pass release meter socket.
 - 3. Unmetered street lighting circuit.
- H. Underground Service Pedestal: As specified, ASTM B 117, and ASTM A 123 (Cabinet), UL E 50076.
 - 1. Enclosure: 0.120 inch galvanized steel or anodized aluminum.
 - a. 0.080 inch galvanized steel or anodized aluminum covers.

- b. Finished surface with an environmental green, baked enamel over zinc-chromate primer as specified, or anodized aluminum. ASTM B 117.
 - c. Bottom access opening.
 - d. Electrical Utility Service Equipment Requirements Committee (EUSERC) approved circuit-closing by-pass release meter socket.
 - e. Baffled ventilation louvers.
- I. Circuit Breaker: Main Breaker
 - 1. Six space metered.
 - 2. Six space unmetered bus.
- J. Detachable, pad-mount base.

2.2 WOOD POWER POLE

- A. Power pole shall comply with local utility electric service requirements.

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with NEC regulations, local utility electric service requirements and standards, and Department standards for all electric service installations
- B. Install underground service pedestal.
- C. Coordinate any utility connection with the Engineer and contact the utility company at least 60 days before the desired connection date.
- D. Verify the exact location, voltage, procedure, and materials required by the utility company.
- E. All underground and riser electrical conductors will be copper rated RHH-USE-RHW.
- F. Ground all electrical equipment, including cabinets in accordance with NEC requirements. Hard draw all ground wires.
- G. Supply all conduit and conductors to power source connection location. Final connection is to be made by the power company.

3.2 POWER SERVICE

- A. Make timely and appropriate arrangements with the local power company for the installation of power service.
- B. The Department will be responsible for all on-going electrical costs.

3.3 WOOD POWER POLE

- A. Install power pole as indicated on plans and in accordance with all Department and local utility standards. Contact the power company 10 days prior to pole installation.
- B. Install wood pole below grade to a minimum depth equal to one-sixth the total pole height. Refer to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, current edition.
- C. When wood pole is installed on a slope of 2:1 or greater, increase the installation depth by 1 times the diameter of the pole (depth is to be measured from the down-slope side of the pole).
- D. Backfill with native material in 1 foot lifts to match surrounding grade. Tamp each lift to 90 percent compaction.

END OF SECTION

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Section 13591

TRAFFIC MONITORING DETECTOR LOOP

Delete Section 13591 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish, install, and test detector loop and detector cable.
- B. Connect detector loop to control cabinet and provide complete functioning detection capability for loops.

1.2 RELATED SECTIONS

- A. Section 02892: Traffic Signal
- B. Section 13551: General ATMS Requirements
- C. Section 13553: ATMS Conduit
- D. Section 13554: Polymer Concrete Junction Box
- E. Section 13555: ATMS Cabinet

1.3 REFERENCES

- A. International Municipal Signal Association (IMSA)
- B. National Electric Code (NEC)

1.4 SUBMITTALS

- A. Certified test report of detector lead-in cable compliance as specified. IMSA 50-2.
- B. Samples of materials for approval when requested.
- C. Provide the following submittals as described in Section 13551:
 - 1. Contractor Furnished Material and Equipment Lists
 - 2. Manufacturer's Equipment Documentation

PART 2 PRODUCTS

2.1 MATERIALS

- A. Follow Section 02892.

PART 3 EXECUTION

3.1 PREPARATION

- A. The number of loops and the number of lanes varies based on location shown in plans.

3.2 SAW CUT

- A. Maximize the area and width of any pavement sections that are created by the saw cuts.
- B. Do not saw cut across a transverse joint in the traveled way.
- C. Saw cut is allowed across a transverse joint in a shoulder slab. To maximize the pavement slabs created, position the cut approximately halfway along the joint.
- D. Maximum allowable distance between saw-cut and transverse joints, or between adjacent saw cuts: 1 1/2 ft.

- E. Loop Spacing: 21 1/2 ft. between leading edges.
Maximum tolerance: 1 inch.
- F. Do not install loops in cracked or spalled pavement.
- G. Avoid water in active traffic during installation.
- H. Shape: Refer to SL series Standard Drawings.

3.3 LOOP WIRE AND LEAD IN CABLE INSTALLATION

- A. Section 02892.
- B. Loops: 4 turns per loop, placed counter clockwise, center all loops in lane.
- C. Use blunt wood sticks to push wire into saw cut. Do not use metal tools.
- D. Tag each loop within the junction box at the termination of the loop wire and within the cabinet at the termination of the detector loop cable (DLC).
- E. Immediately upon installation:
 - 1. Seal loop wire ends with waterproof coating, coil neatly, place in a junction box or a sealed plastic bag, and bury.
 - 2. Install a plywood shield above all buried wire ends.
 - 3. Do not allow loop wire ends be left exposed to the weather.
- F. Install Loop Sealant
 - 1. Fill and encapsulate loop wires and home runs a minimum depth of 1 5/8 inches from the pavement surface.
 - 2. Install embedding loop sealant in saw cuts \pm 1/4 inch from the top of the pavement after curing is complete.
 - 3. Allow sealant adequate time to cure under ambient environmental conditions before lane is re-opened to traffic, or cover loop sealant with sand or cement dust to minimize tire tracking.
 - 4. Refer to manufacturer's specifications regarding expansion of sealant during curing period.
- G. Install detector lead-in cable to from loop wire to cabinet. Refer to Section 13555. Connect cable to input file in cabinet to make loop detection fully functional at cabinet controller location.
- H. Maximum detector lead in cable length allowed: 660 ft.

- I. Pavement Exit
 - 1. Drill 2-inch diameter hole at 45-degree angle at pavement edge.
 - 2. Install conduit originating from splicing junction box to the pavement edge. Extend conduit 3 inches into drilled hole.
 - 3. After loop wires are installed, seal conduit, fill the hole within 1 1/2 inches of road surface with silica sand.
 - 4. Seal remaining hole in the road surface with loop sealant.
- J. Conduit Connection to Junction Box
 - 1. Conduit to be sealed with waterproof bushings. Refer to Section 13553.
 - 2. Fill voids resulting from entrance of conduit into junction box with hydraulic cement grout. Refer to Section 13554.
 - 3. Field locate junction box to avoid drainage areas and steep slopes.
- K. Splicing in junction box
 - 1. No splices allowed between the loop wire and controller cabinet.
 - 2. The only splice allowed is the transition from the loop wire to the detector lead-in cable.
 - 3. Carry the shield over the splice.
 - 4. Splice detector lead-in cable to loop wire in junction box with approved splice encapsulation kit.
- L. All work done in accordance with the National Electric Code (NEC).

3.4 TESTING AND ACCEPTANCE

- A. Perform a Detector Loop Inductance & Resistance Test as described in Section 02892. Obtain UDOT's newest version of the Detector Loop Inductance & Resistance Test form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>. Submit Detector Loop Inductance & Resistance Test to the Engineer for acceptance.
- B. Perform the Local Field Operations Test after all Traffic Monitoring Detector Loop elements, equipment and hardware, power supply, and connecting cabling have been installed.
 - 1. Perform testing after all construction for the site has been completed and the final road surface has been constructed.
 - a. It is not necessary for the communications installation to be completed at the time testing.
 - b. It is not necessary that all stations be locally tested concurrently.

END OF SECTION

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Section 13592

**ROADWAY WEATHER INFORMATION SYSTEM -
ENVIRONMENTAL SENSOR STATION (RWIS-ESS)**

Delete Section 13592 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. RWIS site preparation: install buried conduit per industry standard and associated junction boxes with grounding rods, tower foundation, and fence installation per design plans or as directed by UDOT representative.

1.2 RELATED SECTIONS

- A. Section 02324: Compaction
- B. Section 02330: Embankment
- C. Section 02776: Concrete Sidewalk, Median Filler, and Flatwork
- D. Section 02821: Chain Link Fencing and Gates
- E. Section 03055: Portland Cement Concrete
- F. Section 03211: Reinforcing Steel and Welded Wire
- G. Section 03310: Structural Concrete
- H. Section 13553: ATMS Conduit
- I. Section 13554: Polymer Concrete Junction Box

1.3 REFERENCES

- A. National Electric Code (NEC)
- B. ANSI/UL 467

PART 2 PRODUCTS

2.1 POWER

- A. Use electrical components as listed and defined by the National Electric Code (NEC).
- B. Supply and install conduit, ground rods (NEC 250-1), and junction boxes per Sections 13553 and 13554. Install in each conduit a detectable pull tape. Refer to Section 13553.
- C. Install solar power array and connect with RPU per manufacturer's specifications.

2.2 RPU TOWER FOUNDATION AND SERVICE PAD

- A. Obtain proper compaction according to Section 02324
- B. Use Class AA (AE) concrete per Section 03055.

2.3 TOWER GROUNDING SYSTEM

- A. Wire: 32 strand, #210 weight, 7/16 inch tinned copper ground cable. For all three legs, starting from the outside ground rod, clamp wire and run wire to the ground rod three feet from the tower. Clamp the wire to the ground rod. **DO NOT cut the wire.** Run the wire across the top of the concrete pad (Refer to Section 02776) to the corner of the RWIS tower. Grounding wire to be attached to the tower.
- B. Ground Rod: 5/8 inch diameter 8 foot copper clad. Two per corner; one, 3 feet away and one, 10 feet away. ANSI/UL 467.

2.4 ENVIRONMENTAL SENSORS, REMOTE PROCESSING UNIT (RPU), COMMUNICATION EQUIPMENT, AND TOWER

- A. All sensors to be installed by the Department.

2.5 FENCE AND GATE

- A. Follow Department provided design specification.

PART 3 EXECUTION

3.1 GENERAL

- A. Conform to the requirements of the National Electric Code (NEC).
- B. Tower site location and pavement sensor placement must be approved on site by the Engineer prior to construction.
- C. Provide a preliminary installation schedule to the Engineer 30 days prior to start of work.
- D. Pick up State-furnished materials at the following:
 - Utah Department of Transportation
 - Traffic Operations Center (TOC)
 - 2060 South 2760 West
 - Salt Lake City, Utah 84104-4592
- E. Contact the Engineer seven calendar days before pick-up date.
- F. Install all State-furnished materials per manufacturers instructions, unless noted otherwise.

3.2 RPU TOWER FOUNDATION AND TOWER

- A. Follow Sections 03055 and 03211.
- B. Provide all necessary grading for a flat and level site.
- C. Finish all surface concrete with Ordinary Surface Finish per Section 03310.
- D. Embankments to be installed per Section 02330.

- E. Do not weld conduit to tower. Follow manufacturers installation instructions.
- F. Place the concrete directly into the excavation. Use minimum forming above ground.
- G. RPU tower to be installed by the Department.

3.3 PAVEMENT SENSORS

- A. To be installed by the Department.

3.4 CABINET, PROCESSING UNIT

- A. To be installed by the Department.

3.5 COMMUNICATION EQUIPMENT

- A. To be installed by the Department.

3.6 FENCE AND GATE

- A. Furnish and install Chain Link Fence and Gate per Section 02821.
- B. Furnish and install 7-foot high Type IV fence, with barbed wire and arm, with 5 foot wide gates.
- C. Orient fence gates and size the fence dimensions per manufacturer or Department specifications.

END OF SECTION

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Section 13593

WEIGH IN MOTION

Delete Section 13593 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construct complete weigh in motion (WIM) site, including all labor, materials, equipment, testing, and calibration required for a complete and operational WIM site.

1.2 RELATED SECTIONS

- A. Section 13551: ATMS General
- B. Section 13553: ATMS Conduit
- C. Section 13554: Polymer Concrete Junction Box
- D. Section 13555: ATMS Cabinet
- E. Section 13591 Traffic Monitoring Detector Loop

1.3 REFERENCES

- A. National Electric Code (NEC)

1.4 SUBMITTALS

- A. Provide all of the following submittals as described in Section 13551:
 - 1. Contractor Furnished Material and Equipment Lists
 - 2. Test Reports for the Cable & Conductor Test, the Local Field Operations Test, Piezo Calibration, and the Thirty-Day Burn-In Test

3. Completion Notice
4. Manufacturer's Equipment Documentation
5. As-Built Drawings
6. A Compliance Certificate from the piezo manufacturer for site acceptability.

PART 2 PRODUCTS

2.1 PIEZO ELECTRIC SENSORS

- A. Department Furnished:
 1. Piezo Electric Sensors as follows:
 - a. Commercially-available "Brass Linguini"-style piezo electric sensor.
 - b. Functional between -20 degrees F and 160 degrees F
 - c. Functional in up to 95 percent humidity
 - d. Manufacturer-specified operating life of three years, minimum.
- B. Department provides manufacturer's installation instructions.
- C. Contact engineer for current Piezo Manufacturer contact information.

2.2 CABINET

- A. Use cabinet as shown in plans and details.
- B. Follow Section 13555.

2.3 JUNCTION BOXES

- A. Install junction boxes according to Section 13554.
- B. Install and terminate all conduit according to Section 13553.

PART 3 EXECUTION

3.1 PREPARATION

- A. Conform to the requirements of the NEC.

- B. Contact the Engineer thirty days prior to start of work, to schedule and attend a pre-installation meeting.
- C. Contact the Engineer five business days before picking up Department-furnished materials.
- D. Install all Department-furnished materials following manufacturers' instructions.

3.2 PIEZO ELECTRIC SENSORS

- A. Piezo Install:
 - 1. Cut straight slot, 3/4 inch x 3/4 inch, in one pass, perpendicular to and for the full width of the traffic lane.
 - 2. Drill 1/2 inch diameter 2 inch deep holes, at approximately 45 degrees, at 3 ft spacing, along both sides of saw cut as shown on AT series Standard Drawings.
 - 3. Minimum of 12 inches between saw cut and concrete joints
 - 4. Clean and dry slot prior to placing piezo.
- B. Lead In Wires:
 - 1. Saw cut 1/2 inch wide x 3 1/4 inch to 6 inch deep slot for piezo lead in wires.
 - 2. Cover lead in wire with at least 3 inch of approved embedded sealant.
 - 3. Minimum of 12 inches between saw cut and concrete joints.
 - 4. Locate all lead ins down stream of piezo.
 - 5. Drill 1/2 inch hole at edge of roadway for cover on conduit.
 - 6. One 3/4 inch schedule 40 conduit for each lead in wire outside of roadway.
 - 7. Piezo lead in wire: Long enough to reach the data recorder prior to placing 500 ft maximum.
 - 8. Tag and number each lead in wire for identification.
- C. Refer to AT and SL series Standard Drawings and Section 13591 for loop detector details.
- D. Install all cabling between sensors and processing unit following all manufacturers' installation instructions.
- E. Piezo Calibration:
 - 1. Perform all calibration in accordance with piezo manufacturer's specifications.
 - 2. Arrange to have a representative from the piezo manufacturer and the Engineer or the Engineer's agent present.

3. Submit a report of the successful calibration following the format of the Test Reports described in Section 13551.

3.3 CABINET AND PROCESSING UNIT

- A. Install ATMS cabinet as indicated on plans and details
- B. Follow Section 13555.

3.4 ACCEPTANCE TESTING

- A. Successfully complete the following tests:
 1. Cable and Conductor Test: Obtain UDOT's newest version of the ATMS Cable and Conductor Test form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
 2. Local Field Operations Test: Obtain UDOT's newest version of the Weigh In Motion (WIM) Local Field Operations Test from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
 - a. Test procedure and requirements to be provided by manufacturer.
 - b. Conduct Local Field Operations test after the Cable and Conductor test has been successfully completed and the Engineer has approved the Cable and Conductor Test Report.
 - c. Furnish all equipment, material, and labor necessary for the test.
 - d. Conduct the test after all construction for the site has been completed and final road surface has been constructed.

END OF SECTION

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Section 13594

FIBER OPTIC COMMUNICATION

Delete Section 13594 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnish, install, and test communication system.

1.2 REFERENCES

- A. Section 13551: General ATMS Requirements
- B. Section 13553: ATMS Conduit.
- C. Section 13554: Polymer Concrete Junction Box.
- D. Section 13555: ATMS Cabinet.

1.3 RELATED SECTIONS

- A. Bellcore Testing Requirements
- B. Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA) Specifications
- C. National Electric Code (NEC)
- D. Telcordia Guidance
- E. Underwriters Laboratory (UL)
- F. USDA Rural Electrification Administration (REA) Specifications

1.4 DEFINITIONS

- A. OTDR: Optical Time Domain Reflectometer.
- B. OSP: Outside Plant.

1.5 SUBMITTALS

- A. Provide all submittals in accordance with Section 13551.
- B. Evidence of training and experience for all fiber optic staff, including but not limited to installation technician, splice technicians and test technicians. Include in the file for each technician a resume listing relevant education and experience, and a certificate of completion for the fiber optic training course.
- C. For approval:
 - 1. A detailed construction and installation procedure covering all aspects for the fiber optic cable installation on this project.
 - 2. All materials for the fiber optic cable installation on this project.
 - 3. Fiber labeling setup.
- D. Prior to the splicing of any fiber cable, submit to the Engineer the part number and manufacturer of the cleave tool along with an "end angle" distribution chart which demonstrates the actual 150 cut end angles.
- E. Submit to the Department and maintain on file a current calibration certificate for the OTDR being used.
- F. Submit OTDR test results to the Department in a neatly bound and printed format for acceptance. Electronic submittal to Engineer on floppy disk or CD is also required. All Electronic files will be compatible with Siecor OTDR 383PCW Version 1.21 or higher.
- G. Submit Power Meter/Light Source Test results to the Department for acceptance. Use the test form obtained during the preconstruction meeting or from the Department Fiber Representative.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials are UL listed.
- B. Provide all incidental materials including but not limited to fiber optic jumpers, cable ties, labels, data cables, and connectors.
- C. All materials meet Fluid Penetration Test standards (TIA/EIA-455-82B).

2.2 FIBER OPTIC CABLE

- A. Contact the Engineer for approval of fiber that is to be used. Fiber must be approved by the USDA Rural Electrification Administration (PE-90).
- B. The fiber optic cable is an Outside Plant (OSP) type, nonarmored dielectric loose tube, single-mode cable.
- C. Include the manufacturer's test documentation . This documentation indicates the attenuation of each cable fiber in dB/km, measured at 1310 nm and 1550 nm for single-mode.
- D. Outside Plant (OSP) Single-mode.
 - 1. Fiber Optic Glass: Corning SMF-28E or approved equal.
 - 2. Fiber Optic Cable: Corning ALTOS or approved equal.
- E. Fiber optic cable must comply with Telcordia GR20-CORE and TIA/EIA-4720000-A.

2.3 FIBER OPTIC CONNECTORS

- A. With the following characteristics and as specified on the plans:
 - 1. ST
 - a. Factory installed or field installed ST or ST compatible connectors.
 - b. Ceramic ferrules and metallic connector bodies.
 - c. Maximum insertion loss: 0.30 dB.
 - d. Connector back reflection: greater than 35 dB.
 - 2. LC
 - a. Factory installed or field installed LC or LC compatible connectors.

- b. Ceramic ferrules.
 - c. Maximum insertion loss: 0.30 dB.
 - d. Connector back reflection: greater than 35 dB.
- B. Clean all connectors with alcohol wipes and a compressed cleaning gas.
- C. Furnish and install new spider fan-out kits, to replace any existing fan-out kits that must be severed in order to make ST connections.
- D. Field polishing of connectors: Not acceptable.

2.4 TYPE A AND B FIBER OPTIC CABLE SPLICE ENCLOSURE

- A. Splice enclosures are to comply with Telcordia GR-771 that pass Bellcore Testing Requirements.
- B. Type A: For locations with more than 48 splices.
 - 1. Preformed Coyote Enclosure or approved equivalent
 - 2. One three section (six entry) end plate.
 - 3. One blank end plate.
 - 4. Two or more 36 fiber count fusion splice trays.
 - 5. All required accessories to complete the splice.
- C. Type B: For locations with up to 48 splices.
 - 1. Preformed Coyote Pup Enclosure or approved equivalent
 - 2. One three section (six entry) end plate.
 - 3. One blank end plate.
 - 4. Four 12 fiber count fusion splice trays.
 - 5. All required accessories to complete the splice.

2.5 SPICE ENCLOSURE FIBER DETAILS

- A. Provide 3 feet of buffer tube slack from three section end plate.
- B. Provide label for each buffer tube located 1 inch from the splice tray. Description on label will identify as to which fiber cable and direction cable is coming from.
- C. Provide 3 to 4 feet of fiber optic strands, outside of buffer tube, from each cable before splicing.

PART 3 EXECUTION

3.1 INSTALLERS

- A. Complete a three-day course on the installation, splicing and testing of fiber optic cable.
 - 1. Course: conducted by the supplier of the fiber optic product or established education provider.
 - 2. In house and on the job training is not acceptable.
- B. Demonstrate two years total and one year continuous work experience with the splicing, termination, and testing of fiber optic cable.
- C. Perform all work with qualified staff.

3.2 FIBER OPTIC CABLE INSTALLATION REQUIREMENTS

- A. Do not perform fiber splices that are not shown in approved splice details without prior written authorization from UDOT ITS Fiber Division located at the UDOT Traffic Operation Center, 2060 S., 2760 W., Salt Lake City. Splice all drop cables to the main run of fiber with a mid span entry to the cable, unless shown differently on project plans.
- B. Notify the Engineer 72 hours in advance of fiber optic cable installation into any existing conduit or building facility.
- C. The Engineer may initiate special inspection procedures to verify the condition of existing communications facilities. Observe inspections as desired.
- D. Perform all work in facilities on conduits, junction boxes, cabinets, and buildings for example containing the Department's existing communications equipment only in the presence of Department's representative.
 - 1. Refer to Section 13554 for conduits and junction boxes.
 - 2. Refer to Section 13555 for cabinets.
- E. Restore Contractor damaged facilities within 48 hours.
- F. Lubricate cable with a lubricant designed for fiber optic cable installation.
- G. Use shear pins or other failsafe means to prevent exceeding the maximum cable pulling tension specified by the cable manufacturer.
- H. Maintain the following minimum bend radiuses:

1. 20 times Cable Diameter Short Term During Installation.
 2. 10 times Cable Diameter Long Term Installed.
- I. Maintain the following minimum slack requirements:
 1. Splice Points: 35 ft. from installed splice case to conduit on all cables
 2. All Other Junction Boxes: 15 ft.
 3. Cabinets: 15 ft.
 - J. Replace any fiber optic cable segment not meeting the requirements of the specifications in its entirety between splice points shown on the plans.
 - K. Place the locator wire in the dedicated 1 inch conduit (Refer to Section 13553) as shown in the plan details.

3.3 FIBER OPTIC CABLE PREPARATION

- A. Clean the fibers and buffer tubes using a solvent designed to remove all water blocking gel from each exposed fiber.
- B. Solvent requirements:
 1. Must not remove any color from individual fibers (Refer to TIA/EIA-598-A) or buffer tubes.
 2. Not harmful to the polyethylene cable jacket.

3.4 ENTRY AND REENTRY OF FIBER OPTIC SPLICE CLOSURES

- A. Perform all work in a suitable environment free from excess dust and moisture. Acceptable environments to work on splice closures include office type environments in buildings, splice trailers, and splicing tents with floors.
- B. Do not perform fiber splicing, testing, or connecting in freezing temperatures.
- C. Do not expose open splice closures and fiber ends to rain, snow, or wind-blown dust.

3.5 FUSION SPLICING

- A. All fiber splicing: fusion splice method.

- B. Perform fusion splices as follows:
 - 1. Use equipment with automatic fiber alignment and automatic light injection with detection devices or profile alignment algorithms to estimate splice losses.
 - 2. Provide splice closure as a protection for all splices and stripped cable.
 - 3. House all splices in splice trays or organizers.
 - 4. Use glass capillaries, heat shrink tubing, or silicone sealant to provide additional protection and strain relief.
 - 5. Comply with maximum splice loss allowance of 0.05 dB.
- C. Install new splice enclosure end plates at each location where there is a new fusion splice in an existing splice enclosure per manufacturer's recommendations.

3.6 CABLE LABELING REQUIREMENTS

- A. Label all fiber optic cables with a high quality permanent label, indicating the street name or location and type of circuit (drop cable, distribution, backbone-96 count).
- B. Use Panduit MP-150-C or equivalent.

3.7 ACCEPTANCE TESTING

- A. Contact the Engineer 72 hours prior to performing all acceptance testing (Post Termination and Splicing OTDR and Power Meter).
- B. Perform all fiber optic testing with an OTDR capable of producing output files compatible with the Siecor OTDR 383PCW Version 1.21 or higher.
- C. Repair any damaged fiber strands using fusion splicing methods and repeat all tests described below.
- D. OTDR Testing Requirements:
 - 1. After completing the required work, test every fiber strand passing through any open splice tray.
 - 2. Conduct all traces with a pigtail or fiber box between the OTDR and the fiber under test. Use pigtail of sufficient length as to show the connector, or the start of the strand under test.
 - 3. Do not exceed launch transition of 0.6 dB.
 - 4. Conduct all traces at both 1310 nm and 1550 nm.
 - 5. Unless otherwise noted, uni-directional traces are acceptable.
 - 6. Provide traces with the following information:
 - a. Horizontal Axis: Distance in Feet and Kilometers.

- b. Vertical Axis: Attenuation scale in dB.
- c. Traces showing attenuation versus distance.
- d. Cursors positioned at cable ends.
- 7. Tabulate for each trace: method, fiber type, wavelength, pulse width, refraction index, range, search threshold, reflection threshold, end threshold, warning threshold, backscatter, jumper length, file date, file time, fiber ID, cable ID, OTDR location, far end location, operator initials.
- 8. Provide an event table showing all events having more than 0.05 dB loss, containing event type, position from OTDR end, loss and reflectance.
- 9. For cables less than 3300 ft (1 km) in length, the maximum total allowable attenuation is 1.0 dB.
- 10. Identify fibers by strand number.
- 11. Submit results in printed form on 8 ½ x 11 paper in a suitable binder organized by cable and strand number.
- 12. A cover sheet is required for each binder indicating which cable(s) were tested, the OTDR users name, the reviewers name, the type of test performed and the date(s) of the test.
- 13. Cover sheets for final test results bearing the reviewers signature, the date, and a statement indicating that the installation complies with the requirements of this section is required.
- 14. The Contractor's employee who has reviewed the traces is required to sign or initial them. A check mark is required on all traces that satisfy the requirements identified herein. For intermediate test results, flag any discrepancies that may exist with a short description of the proposed corrective action. (e.g. resplice).
- 15. Submit to the Engineer on 3 ½ inch floppy disk or CD electronic media with a printed index.

E. Receiving Test:

- 1. Fibers Tested: Normally, one strand per buffer tube. Test every strand when evidence of physical damage exists or when any damaged strand is found.
- 2. Light Frequency: 1310 nm and 1550 nm.
- 3. Direction: Uni-directional.
- 4. Location of test: Contractor's yard.
- 5. Test after receiving material, before releasing to installation crew.
- 6. Tested by: Qualified Staff.
- 7. Cable meets factory attenuation specifications.
 - a. Cable attenuation 0.4 dB/km at 1310 nm.
 - b. Cable attenuation 0.25 dB/km at 1550 nm.
 - c. Strand lengths are consistent.
 - d. Launch Transition < 0.6 dB.
 - e. No event > 0.10 dB.
- 8. Trace available for one strand in every buffer tube in the cable.

- F. Post Blowing/Pulling - Pre Splicing Test:
1. Fibers Tested: Normally, one strand per buffer tube. Test every strand when evidence of physical damage, excessive pulling tension, and kinks exist, or when any damaged strand is found.
 2. Light Frequency: 1310 nm and 1550 nm.
 3. Direction: Uni-directional.
 4. Location of test: One field location for each cable installed.
 5. Test after installing cable in duct but before splicing.
 6. Tested by: Qualified Staff.
 7. Witnessed/Approved by: Department inspector may witness and must approve before splicing.
 8. Acceptance Criteria:
 - a. Cable attenuation 0.4 dB/km at 1310 nm.
 - b. Cable attenuation 0.25 dB/km at 1550 nm.
 - c. Strand lengths are consistent.
 - d. Launch Transition < 0.6 dB.
 - e. No event > 0.10 dB.
 9. Trace available for one strand in every buffer tube in the cable.
- G. Post Termination and Splicing Test:
1. Test every strand in all cable segments including connectorized strands of drop cables.
 2. Light Frequency: 1310 nm and 1550 nm.
 3. Direction: Unidirectional.
 4. Location of test: Every field location required to obtain access to each cable segment.
 5. Test after terminating and splicing at all points shown on the plans.
 6. Cable Tested by: Certified Staff.
 7. Department inspector witnesses and approves before final approval by the Engineer.
 8. Acceptance Criteria:
 - a. Cable attenuation 0.4 dB/km at 1310 nm excluding splices shown on the plans or authorized by the Engineer.
 - b. Cable attenuation 0.25 dB/km at 1550 nm excluding splices shown on the plans or authorized by the Engineer.
 - c. Strand lengths are consistent.
 - d. Launch Transition < 0.6 dB.
 - e. No event > 0.30 dB.
 - f. Maximum splice attenuation 0.05 dB per splice unless otherwise shown on the plans.
 9. Trace available for each strand in all cable segments.

- H. Power Meter/Light Test:
1. Connect the light source to the connectorized fiber at the location identified on the Fiber Optic Light Source Power Meter Test Form provided by the Resident Engineer or Department Fiber Representative at the pre-construction meeting. Connect a power meter to the other end of the fiber at the location identified on the Test Form. Record the results and submit the completed form to the Engineer.
 2. Use the light frequencies of 1310 nm and 1550 nm, or as indicated in test forms.
 3. Perform the test bi-directional.
 4. Test every field location required to obtain access to each cable segment.
 5. Perform all testing using a qualified staff member.
 6. A Department inspector witnesses and approves the results before final approval by the Engineer.
 7. Acceptance Criteria:
 - a. Cable attenuation as called for in test plans.
 - b. Test is available for each strand indicated in test plans. Otherwise, test will be available for each strand in each cable segment.
- I. All work to conform to the National Electric Code.

END OF SECTION

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Section 13595

ATMS INTEGRATION

Delete Section 13595 and replace with the following:

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Integration of all appropriate ATMS devices, including successful completion and documentation of all field operational tests.
- B. Install and connect all incidental equipment as required for a complete and operational system.

1.2 RELATED SECTIONS

- A. Section 13551: General ATMS Requirements

1.4 SUBMITTALS

- A. In accordance with Section 13551.
- B. Test report for the Thirty-Day Burn-In Test.

PART 2 PRODUCTS Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTING

- A. Provide a Completion Notice per Section 13551 once Local Field Operations Tests have been successfully completed on all devices. Notify the Engineer of readiness to begin the Integration Task.
- B. Integration requires the successful completion of a Thirty-Day Burn-In Test, consisting of the verification of valid data and control at the communications demarcation point for all devices. Obtain UDOT's newest version of the 30 Day ATMS Burn-in Test Report form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>.
- C. Furnish all necessary test materials and cables and connectors to complete and test the integration of the ATMS device.
- D. Notify the Engineer at least five working days in advance of the proposed date upon which the Acceptance Tests will take place. Obtain UDOT's newest version of the 5-Day ATMS Testing Pre-Notification form from the UDOT Web site. Refer to <http://www.udot.utah.gov/index.php/m=c/tid=719>. The Engineer witnesses the Acceptance Tests or designates an individual or entity to witness the Acceptance Test on the Department's behalf.
- E. Once the Local Field Operations Test has been successfully completed on all sites, the Engineer may grant Partial Acceptance of the project. The Thirty-Day Burn-In period begins at this time. Begin the Thirty-Day Burn-In period for all ATMS devices of the same type on the same day.
- F. Operate the device on a daily basis during the Thirty-Day Burn-In period noting the results on the 30-Day Burn-in ATMS test form.
 - 1. Accomplished by Department staff along with the contractor.
 - 2. The Traffic Operations Center (TOC) staff may also help verify the daily equipment operation if at the time of testing, communications are consistently provided from the site to the TOC.
- G. Promptly remedy the defect in the event of a failure of Contractor furnished equipment or workmanship.
 - 1. Provide the Engineer with a Completion Notice.
 - 2. Restart the Thirty-Day Burn-In period re-starts for that device.

3. The Engineer may identify an independent third party to specify what defects (if any) must be addressed in order for the work to meet the specifications in the event of a second failure at the same device.
 - a) At the Contractor's expense if defects are identified, otherwise Department covers the third party's costs.
 4. The Engineer may authorize others to complete the work at the Contractor's expense if the Contractor fails to remedy any identified deficiencies in the work within the time required by the Engineer.
- H. Troubleshoot all problems.
1. Suspend the thirty-day test while the problem is corrected on state furnished item.
 2. Resume testing follow resolution.
- I. Engineer grants Final Acceptance after the Thirty-Day Burn-In period is complete and all required documentation has been received.

END OF SECTION